MONTANA WATER QUALITY

1986

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Prepared by the

Water Quality Bureau
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Helena, Montana 59620

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The 1986 Montana 305(b) Report

May, 1986

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SUMMARY

One of Montana's most treasured resources is water A vital necessity of life, its value continues to increase with time. Becoming wise stewards is essential to preserving this resource for future generations.

Creating a legacy of clean water requires time, cooperation, knowledge and funding from a broad spectrum of people and organizations. To this end, Montana has established close working relations with local, state and federal government agencies, neighboring states and provinces.

The job isn't easy. Efforts to protect water quality sometimes are successful, sometimes not. Many solutions take years. Sometimes problems are discovered, but there's no information to provide answers. Also, there are many problems waiting to be discovered.

This report provides a review of what has happened in the last two years and gives insights to future plans.

Montana's most pressing water quality problems include:

Streams--Sections of 107 Montana streams have predominately man-caused problems that could be improved. This accounts for about 4,662 miles of degraded rivers and creeks

Lakes--A cooperative statewide inventory of lakes resulted in the creation of a computerized data base which now contains information on 1,984 lakes. During the last two years, 18 lakes were closely monitored with special attention paid to studying relationships between nutritional status and physical and chemical parameters.

Wetlands--A National Wetlands Inventory sponsored by the federal government will help identify wetlands in Montana, but a great deal of work remains before state and federal agencies have an adequate information base that identifies all wetland areas. Since the last report, naturally occurring selenium was found in central Montana wetlands, and studies were started to identify the scope of the problem.

Ground water--Although there is no major threat to ground water in Montana, each year more local problems occur. Some of the major contaminants include fertilizers, pesticides, hydrocarbons and heavy metals. During the last two years, 14 ground water pollution control permits were issued, and about 40 incidents were investigated for possible pollution. Four sites revealed cyanide from mining leach operations, and 15 locations were investigated for fuel leaking into the groundwater. A total of seven businesses are planning stringent monitoring programs as part of completing applications under the Montana Hazardous Waste Act. Additionally, Montana now has seven Superfund sites, and 24 more sites are being investigated for inclusion in the CERCLA program. All of these sites include ground water investigation, and in some cases, actual clean-up work.

Special problems include:

1) Eutrophication of Flathead Lake,
2) Maintaining water quality in the Clark Fork River
3) Saline seep and sodbusting,
4) Riparian zone management,
5) Stream dewatering,
6) Cumulative impacts on multiple-owned forest watersheds,
7) The control of sediment and nutrients from non-point sources,
8) Acid deposition,
9) Gas entrainment,
10) Providing safe drinking water,
11) The discharge of brackish waters into fresh surface waters and
12) The many environmental and social problems associated with toxic algae blooms.

Efforts to control Montana's wide range of water quality problems include:

Public Water Supply--The program purchased a networking system of IBM personal computers which should result in a savings of staff time. The program also is investing a considerable amount of time and resources in testing public water systems for the presence of *Giardia*.

Control Programs--The job of water pollution control cannot be done alone; it takes community effort to produce successful programs. The DHES works in unison with local, state and federal groups and agencies to control point and nonpoint sources of pollution. These efforts range from rather basic information at specific sites to being part of a cooperative nationwide computer data system.

Point Source Control Programs--The Permits and Enforcement Section administers about 340 individual discharge permits. Personnel have been working with the Environmental Protection Agency to implement industrial pretreatment programs in larger Montana municipalities. In enforcement, 267 complaints were investigated by the DHES; 51 incidents were given to the Legal Division; 20 administrative enforcement orders were issued; 32 civil complaints were filed in district court; 23 civil cases were resolved by stipulations; $60,000 in civil penalties were collected and $12,714 in DHES enforcement costs were recovered in 1984 and 1985.

Construction Grants--During the last two years, 16 municipal wastewater treatment plant construction projects were completed. Additionally, a limit on phosphorus levels in Flathead Basin effluents prompted communities discharging wastewater to begin designing facilities to remove phosphorus. Another important program is the land application of sewage sludge. Currently eight communities are applying sewage sludge to agricultural lands.

Monitoring--Montana's monitoring efforts concentrated on improving

quality assurance, detecting heavy metals and refining data management systems.

Special monitoring efforts included: Monitoring for a variety of parameters in both the upper and lower Clark Fork River; investigating eutrophication in Flathead Lake; doing before and after monitoring at wastewater treatment plants that were upgraded; monitoring flows discharged from Freezeout Lake to the Teton River; investigating the sediment and metals problems in Stanley Creek; studying sediment and turbidity in the Upper Yellowstone River; and creating an information base for developing instream flow reservations for the Missouri River.

Special Programs--The programs that exemplify local, state, federal and, in one instance, international cooperation to solve water quality problems are the Flathead Basin Commission, Flathead Lake Phosphorus Strategy and the Clark Fork River Basin Project. All continued to make progress in improving and protecting water quality.

The principal goals of water quality management as stated in the federal Clean Water Act have been to make "waters fishable and swimmable by 1983" and eliminate discharge of pollutants by 1985. Although the target dates have passed, the goals remain for future accomplishment. In keeping with this direction, the DHES will continue to 1) reduce the backlog of identified polluted waters, 2) prevent degradation of high quality waters and 3) evaluate costs and benefits of each program

FORWARD

The 1986 report on Montana water quality represents the most comprehensive assessment of the quality of water resources that has been prepared to date. While it identifies several stream segments where beneficial uses have been in some way impaired, it also describes improved stream conditions and continuing programs that, with adequate support, can deal with identified problems.

The coming years may pose one of the greatest challenges to continued water quality improvements, and may be a critical time for water pollution control programs in Montana. Our current programs continue to provide both a good evaluation of known problems and an indication of future areas of concern.

Threatened budget reductions at both the state and federal levels may have a dramatic impact on our ability to adequately deal with problems. During such a budgetary crisis, a plan for addressing the state's water quality problems becomes more essential. As financial resources become difficult to obtain, it becomes increasingly important to ensure that those resources are being used in the most productive way. During such times a report such as this becomes an important tool in the overall water pollution control program. We trust this document will guide us through these difficult times.

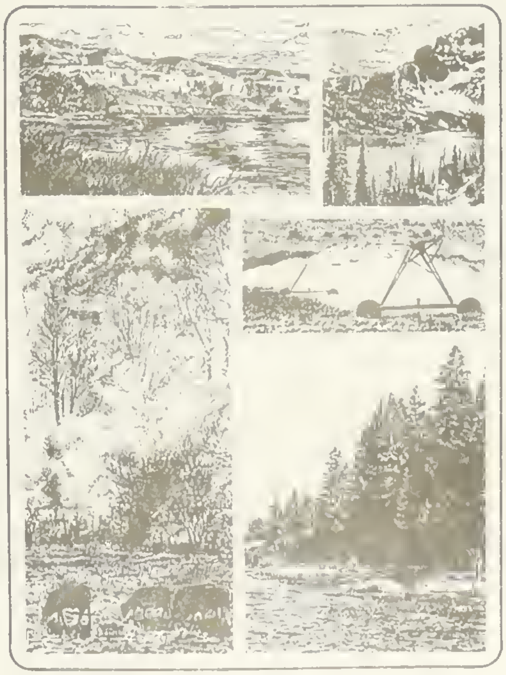
Steven L. Pilcher, Chief
Water Quality Bureau
June 12, 1986

1. INTRODUCTION

Section 305(b) of the federal Clean Water Act (Public Law 92-500) requires each state to submit a biennial report to the U.S. Environmental Protection Agency (EPA) describing the quality of its surface waters. Section 106(e)(1) of the act extends this reporting requirement to include ground water quality. This is Montana's 1986 305(b) Report to EPA.

State government has assumed primary responsibility for several key programs to protect and restore water quality in Montana. For these programs, the EPA serves in a capacity of oversight and technical support, and shares program expenses with the state. At this time of faltering economies and tightening budgets, both the state and EPA are attempting to better focus their limited resources on priority water quality problems and manage water quality programs for maximum environmental results. This report is intended to facilitate achievement of these objectives.

The 305(b) water quality assessment is the leading document in Montana for guiding water quality management decisions and for reporting on progress in dealing with problems the state is facing. EPA, both Region VIII in Denver and headquarters in Washington, D.C., uses the biennial 305(b) reports in many ways. EPA in turn is required to transmit these reports to Congress, along with an analysis of the quality of the nation's waters.



2. BACKGROUND

Montana is a big, varied and sparsely settled state. While it ranks fourth in area among the states, it has less than one million people and the sixth smallest population. The varied topography supports near-desert, grassland, forest and alpine ecosystems. Precipitation falling on Montana drains to three oceans via three major river systems: the Clark Fork-Columbia, the Missouri-Mississippi, and the Saskatchewan-Nelson. Natural waters range in quality from the almost distilled water of some headwater lakes and streams in the west to waters exceeding the salinity of seawater in the eastern part of the state.

The following background information will give the reader some additional perspective for the assessment data contained in this report:

State population: 786,690 (1980 census)

State surface area: 147,045 square miles

Number of river basins: 16 basins

*Total stream miles: 20,532 miles (estimated)

Names and mileages of border rivers: none

Number and area of lakes, reservoirs and ponds: 4,018 lakes = 756,450 acres (estimated)

Number and area of lakes and reservoirs larger than 5,000 acres each: 12 lakes = 520,450 acres

Area of wetlands = 2,000,000 acres (estimated)

The several classes of waters in the Montana Surface Water Quality Standards reflect the varied natural conditions in the state (Table 2-1 and Figure 2-1). The official status of a few streams (classified as "E" in the Standards) reflects the near-permanent damage caused by resource exploitation in Montana's past.

Montana's major industries are agriculture, forest products, recreation and tourism, coal and metals mining and oil and gas production. As elsewhere, agriculture in Montana is suffering serious economic problems. Similarly, low market values in recent years have severely curtailed oil exploration and production and the mining and

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* This figure is based on the number of stream miles (19,505) in the Montana Department of Fish, Wildlife and Parks (DFWP) stream data base as of April 9, 1986, which is estimated to be 95% of the stream miles in Montana that support fish. The number of stream miles classified under the Montana Surface Water Quality Standards is unknown, but is somewhat larger than the number of miles that support fish.

Table 2-1. Water-use descriptions for different water classifications in Montana. Source: Montana Surface Water Quality Standards, Administrative Rules of Montana (ARM), Title 16, Chapter 20. (See also Figure 2-1.)

16.20.616 A-CLOSED CLASSIFICATION: (1) Waters Classified A-Closed are suitable for drinking, culinary and food processing purposes after simple disinfection.

16.20.617 A-1 CLASSIFICATION: (1) Waters classified A-1 are suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities.

16.20.618 B-1 CLASSIFICATION: (1) Waters classified B-1 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

16.20.619 B-2 CLASSIFICATION: Waters classified B-2 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

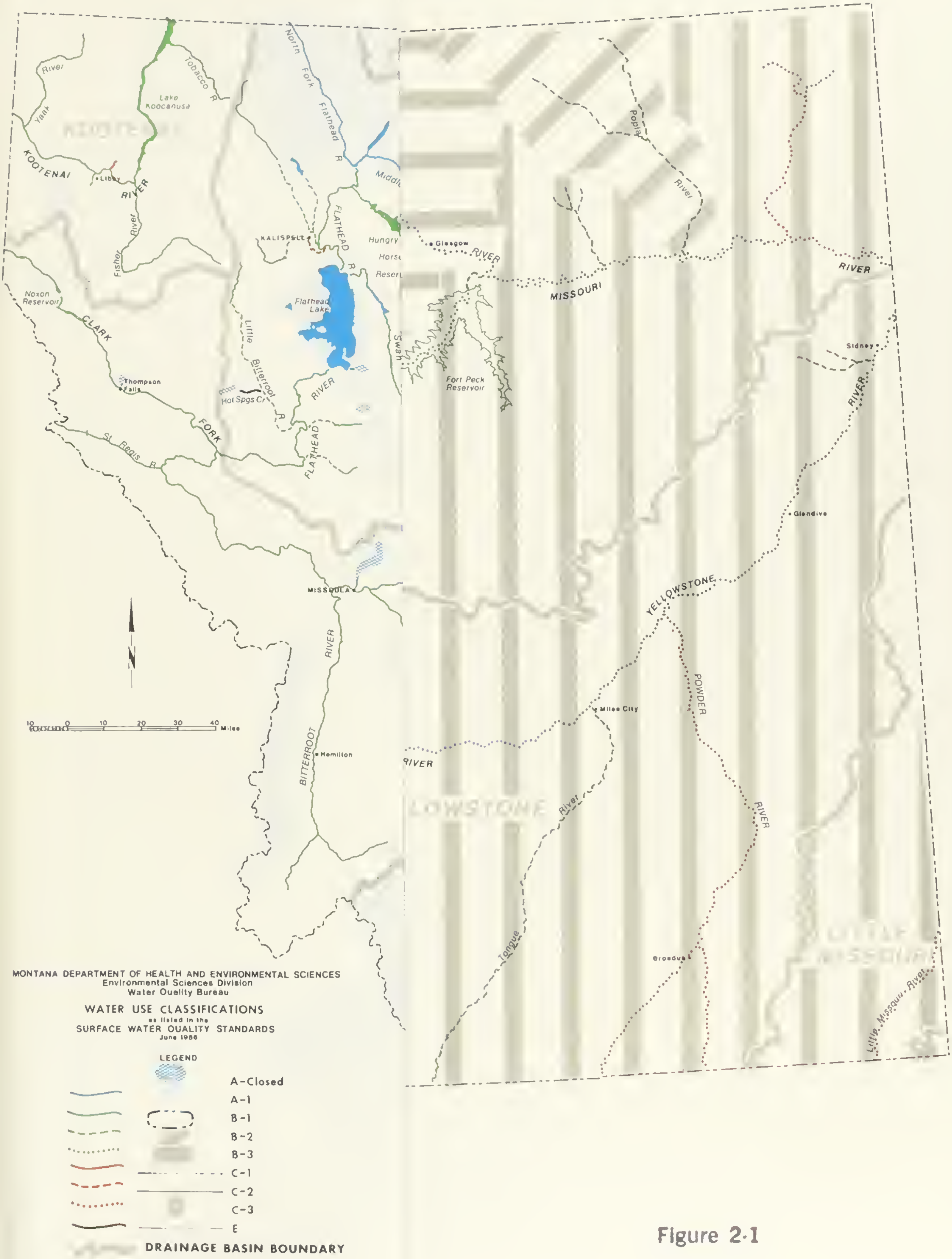
16.20.620 B-3 CLASSIFICATION: (1) Waters classified B-3 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

16.20.621 C-1 CLASSIFICATION: (1) Waters classified C-1 are suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

16.20.622 C-2 CLASSIFICATION: (1) Waters classified C-2 are suitable for bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

16.20.624 C-3 CLASSIFICATION: (1) Waters classified C-3 are suitable for bathing, swimming and recreation, growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers. The quality of these waters is naturally marginal for drinking, culinary and food processing purposes, agriculture and industrial water supply. Degradation which will impact established beneficial uses will not be allowed

16.20.623 E CLASSIFICATION: (1) Waters classified E are suitable for agricultural and industrial water uses other than food processing.



MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
Environmental Sciences Division
Water Quality Bureau
WATER USE CLASSIFICATIONS
as listed in the
SURFACE WATER QUALITY STANDARDS
June 1986
LEGEND
A-Closed
A-1
B-1
B-2
B-3
C-1
C-2
C-3
E
DRAINAGE BASIN BOUNDARY
Miles
KOOTENAI
RIVER
Yaak River
Tobacco R
Lake Koocanusa
Libby
Fisher River
North Fork Flathead R
Middle
KALISPELL
FLATHEAD R
Hungry Horse Reservoir
Flathead Lake
Swan
Little Bitterroot R
Hot Spgs Cr
RIVER
FLATHEAD
Noxon Reservoir
CLARK FORK
Thompson Falls
St Regis R
MISSOULA
RIVER
BITTERROOT
Hamilton
Glasgow
RIVER
MISSOURI
RIVER
Poplar
River
Fort Peck Reservoir
Sidney
RIVER
Glendive
YELLOWSTONE
Miles City
RIVER
POWDER
RIVER
River
Tongue
Broadus
Little Missouri River

Figure 2-1

processing of copper and other base metals. On the other hand, there has been a resurgence in mining of gold, silver and other precious metals Timber harvest is shifting from private to public (mostly U.S. Forest Service) lands, where the harvest rate is accelerating. Meanwhile the recreational use of public lands and waters is increasing. Montana has relatively little in the way of manufacturing and heavy industry.

3. SURFACE WATER QUALITY

A comprehensive assessment of surface waters based on an analysis of all available information is essential as a basis for planning and conducting water quality management programs. The purpose of this problem assessment is to direct water quality management activities to where they will be the most effective. This is particularly important today because of the few resources available to correct a large number of pollution problems.

State standards and federal criteria have been established to serve as yardsticks by which water quality can be measured. An additional measure of water quality is Montana's progress toward the interim goal of the Clean Water Act: that, wherever attainable, fishable and swimmable water quality be achieved.

3.1. STATUS

Not all waters in Montana can be routinely monitored every two years because of resource constraints. However, this does not necessarily mean that an assessment of the quality of these waters cannot be made. Quantitative information (such as data from fixed station monitoring, intensive surveys, stream surveys, creel surveys, reports from fish and wildlife personnel, etc.) is often available, and when using professional judgement, can provide a reasonable assessment of the condition of a body of water.

Additional information on status of lakes and streams is found throughout this report, most importantly in sections 3.3. (Nonsupport of Designated Uses) and 6.2. (Nonpoint Source Problem Areas).

3.1.1. RIVERS AND CREEKS

The Department of Health and Environmental Sciences (DHES) used the severity analysis procedure developed by the EPA Region VIII office to assess problem stream segments in Montana. This assessment builds on the assessment presented in the 1984 305(b) Report: Data collected between August 1983 and September 1985 were used to update and expand the 1984 analysis of problem stream segments.

The severity index values presented in this report are subject to the same limitations discussed in the 1982 Montana Water Quality Report. They are intended only as first-order approximations of water quality, and are to be used with circumspection. Because of the different method used to generate the 1986 severity index values, they cannot be compared directly with values produced in 1982 or with those generated by other states. However, they are comparable with values presented in the 1984 Montana 305(b) Report.

A separate assessment of streams in Montana that are affected by nonpoint sources of pollution was prepared by the DHES in 1985 as a contribution to the national nonpoint source assessment coordinated by the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA). (See Section 6.2.) The ASIWPCA assessment

included many additional problem stream segments that, in the judgement of local resource managers, have impaired uses from nonpoint sources, but for which quantitative water quality data are not available. The DHES will attempt to validate use impairment in these stream segments as resources allow.

3.1.1.1. METHOD

The method used to identify and rank apparent and potential problem stream segments in Montana is a variation of the technique developed by the EPA, Region VIII. It is based on the number of times and the degree to which specific water quality criteria are exceeded. If a criterion is exceeded, it is assumed that an existing or potential beneficial use is impaired. If a beneficial use of the water is impaired, then the water is presumed polluted and a problem exists. Implicit in the technique are other assumptions, which are explained below.

The assessment method that the DHES applied to Montana stream segments in 1986 has many steps:

Step 1. A matrix was prepared in which criteria values for individual variables (parameters) are listed for each beneficial use (Table 3-1). Values for each criterion reflect Montana conditions and water quality standards. (Six minor changes to the 1984 matrix were made to better reflect Montana conditions and standards.) It was assumed that each segment is now, or has the potential of being, used for five of the six beneficial uses: warm or cold water aquatic life, drinking water supply, primary contact recreation, irrigation and livestock watering. The livestock watering category might also apply to wildlife watering. It was also presumed that conventional potable water treatment technology generally is not effective for removing or treating all constituents under the public water supply category in the matrix. It should be noted that few problem stream segments are now used for public water supply, even though criteria for this use were applied to all segments;

Step 2. Data in the Montana water quality data storage and retrieval system as of September 17, 1985, were put into STORET. It was presumed that all water quality information accurately represented instream conditions and met EPA quality assurance guidelines;

Step 3. A request was made to the Data Analysis Branch, EPA Region VIII, Denver, to perform problem severity analyses (using Montana's customized matrix and EPA's computer program and facilities) for all Montana water quality stations having data in STORET collected after August 1, 1983. Severity analyses were produced for 741 stations having data in STORET collected between August 1983 and September 1985 A list of monitoring stations used in the severity analyses is available on request from the DHES;

Step 4. Among all the segments showing some use impairment, those having predominantly man-caused water quality problems were picked for further evaluation This selection was based on the nature of the

Table 3-1. Water quality criteria matrix (criteria values in milligrams per liter unless otherwise noted).

Variables	Uses/Criteria					
	# 1	# 2	# 3	# 4	# 5	# 6
Dissolved oxygen	7.0	5.0				
Fecal coliforms (no./100 ml)				200	1000	
Nitrite as N	0.05	0.05	1.0			10.0
Nitrate as N			10.0			
Nitrite and nitrate as N			10.0			100
Total ammonia			0.5			
Un-ionized ammonia	0.03	0.03				
Total inorganic N	1.00	1.00				
Total phosphorus	0.10	0.10		0.10		
Total dissolved solids			500		1200	10000
Conductance (micromhos/cm)					1800	
Turbidity (NTU)	10	50				
Total suspended sediment	30	90				
Chloride			250		700	
Sulfate			250			
Cyanide	0.022	0.022	0.2			
Sodium					160	
Sodium adsorption ratio					5.0	
Fluoride			2.4		15.0	2.0
Arsenic	0.44	0.44	0.05		0.10	0.20
Barium			1.00			
Boron					0.75	5.00
Chromium VI	0.021	0.021	0.05		1.00	
Iron	1.0	1.0	0.3		20.0	
Manganese			0.05		10.0	
Selenium	0.26	0.26	0.01		0.02	0.05
Mercury	0.004	0.004	0.002			0.010
Temperature (C)	19.4	26.6				
Temperature (F)	67.0	80.0				
Copper**	0.012	0.012	1.0		5.0	0.5
Lead**	0.004	0.004	0.05		10.0	0.10
Zinc**	0.037	0.037	5.0		10.0	25.0
Cadmium**	0.003	0.003	0.01		0.05	0 05
Chromium III**	4.7	4.7	17.8			
Nickel**	1.8	1.8	0.015		2.0	
Silver**	0.004	0.004	0.05			
pH (minimum)	6.5	6.5	6.5	6.5	4.5	
pH (maximum)	8.5	9.0	8.5	8.5	9.0	

* Beneficial Uses:

1 -- cold water aquatic life;
2 -- warm water aquatic life;
3 -- public water supplies;
4 -- primary contact recreation;
5 -- irrigation;
6 -- livestock watering.

** Specific criteria for the protection of aquatic life are based on water hardness. Criteria values given are based on a water hardness of 100 mg/l.

problem parameter(s) and on knowledge of probable pollution sources and natural background water quality. Streams identified in the ASIWPCA assessment were determined to have predominantly man-caused water quality problems;

Step 5. Use impairment values were averaged over all stations considered to be representative of water quality in the reach in question. Then the average use impairment values were totaled to get a severity index value for the reach. Included in the severity index value is only one impairment value for aquatic life -- either cold water or warm water -- depending on the classification of the segment for fish propagation as prescribed by the Montana Surface Water Quality Standards. Streams providing for the marginal propagation of salmonid fish (Class B-2) were considered "cold water" streams;

Step 6. If insufficient data were collected since August 1, 1983 to reassess the status of a stream segment that was identified as a problem in the 1984 305(b) Report (using data collected from 1975 to 1983), then the severity index value in the 1984 report was adopted. Otherwise, severity index values based on the newer information were adopted.

Step 7. Finally, severity index values for problem segments were qualified with certain non-quantifiable factors that influence and reflect the severity and relative importance of each pollution problem. These are the factors:

a. Downstream use(s) impaired (code letter A)

This factor was applied if one or more uses in the next downstream lake or stream segment were likely impaired due to pollution originating in the problem segment.

b. Improved water quality attainable (code letter B)

This factor was applied if the problem is largely man-caused and manageable under existing regulatory authority and pollution control programs, assuming adequate funding for cleanup is provided.

c. Large population affected (code letter C)

Some problem segments are in Montana's more populous areas where immediate and downstream impacts affect a large share of the state's population.

d. Valued resource affected (code letter D)

In most cases, the criterion for this factor was whether the problem affected a "highest-value fishery resource" as defined by the DFWP. This stream classification is similar to the "blue ribbon" classification formerly applied by the DFWP to designate the best quality fishing waters in the state. In other cases, the

factor was applied to waters that are locally unique, although not among the most prized statewide.

e. Interstate, national or international issue (code letter E)

This factor was applied in cases where the pollution problem crosses a state or international boundary or, in the case of Soda Butte Creek in Yellowstone National Park, where a nationally-valued resource is affected.

f. Local interest and involvement (code letter F)

The principal criterion for this factor was whether the local conservation district identified the problem in its water quality plan. Other expressions of local interest also were considered.

g. Unnatural flow fluctuation (code letter G)

Unnatural flow fluctuations can add another element of stress to fish and aquatic life. Excessive withdrawals for irrigation can result in critically high summertime temperatures and concentrated pollutants. The criterion for this factor was whether the problem segment in question has "water removed or fluctuated for agriculture, power, industry, municipal or other" purposes as recorded in the Montana Interagency Stream Fishery Data Base. Information in this category was provided by the DFWP.

The method used to generate problem segment severity index values is unique to Montana. These values are intended only as a guide for allocating available resources and for directing water quality management activities within the state. They cannot be compared with other states' values, either to assess relative problem severity or as the basis for allocating water pollution control funds.

3.1.1.2. PROBLEM SEGMENTS

Using the method just described, the DHES identified 107 Montana streams or stream segments that have predominantly man-caused water quality problems that could be improved by existing regulatory authority and/or pollution control programs, resources permitting (see the Appendix, Table 3-2 and Figure 3-1). This represents an increase of 37 problem stream segments over the number listed in the 1984 305(b) Report. Most of these new segments were added because they were identified in the ASIWPCA nonpoint source assessment (see Section 6.2.) and because they have recent (post-1983) data on STORET indicating that one or more beneficial uses are impaired. These 107 problem stream segments account for 4,662 miles of degraded rivers and creeks in Montana*

* To lend perspective to this figure, there are about 20,532 miles of streams in Montana that support fish, of which 19,505 miles have been at least minimally assessed for biological and (or) chemical water quality parameters

Table 3-2. Montana stream segments having predominantly man-caused water quality problems verified by data on STORET that could be improved by existing regulatory authority and pollution control programs, resources permitting.

Map No. (1)	Stream Segment (2)	Estimated Length (miles)	Basin	Probable Impaired Uses (3)	Pollution Sources (4)	Severity Index (5)	Control Programs (6)
1	Beartrap Cr. below Mike Horse Dam and Adit	1	Upper Clark Fork	A(C),P	1M	70.14 A,B	1
2	Fisher Cr. below Glengary Mine	3	Upper Yellowstone	A(C),P,R,1,L	IM	60.71 B,F	1
3	High Ore Cr. below Comet Mine	4	Upper Missouri	A(C),P,1,L	1M,M	47.71 A,B,F	1,7
4	Corbin Cr. (tributary of Spring Cr./Prickly Pear Cr.) (2)	3	Missouri-Sun-Smith	A(C),P,R,1,L	1M	47.36 A,B,C,F	1
5	Bozeman Cr. below Bozeman	1	Upper Missouri	A(C),R	O,U,A,IA	43.42 A,B,F,G	2,5
6	Reese Cr.	8	Upper Missouri	A(C),R	A,1A	39.96 A,B,F,G	2
7	Pipestone Cr. (2)	22	Upper Missouri	A(C),P,R	A,HM,N	39.42 B,F	2,6,7
8	Mike Horse Cr. below Mike Horse Mine Adit	1	Upper Clark Fork	A(C),P,I	1M	34.61 A,B,F	1
9	Camp Cr.	25	Upper Missouri	A(C),R,1	A	30.12 B,F,G	2
10	Galena Cr. (tributary of Dry Fork Belt Cr.)	2	Missouri-Sun-Smith	A(C),P	1M	29.36 A,B,F	1
11	Depot Cr. below Browning WWTP	1	Marias	A(C),P,R	Browning WWTP	28.42 A,B	3,5
12	Sand Coulee Cr.	13	Missouri-Sun-Smith	A(C),P,R,1	1M,A	28.18 B,F	1,2
13	Old Maid's Coulee below Cut Bank WWTP	2	Marias	A(C),P,R,1	Cut Bank WWTP,N	25.81 B	3,5
14	Powder R. (2)	218	Lower Yellowstone	A(W),P,R,1	I	23.31 A,B,E,F	5
15	Ashley Cr. below Kalispell WWTP (2)	7	Flathead	A(C),P,R,I	Kalispell WWTP,A	21.47 A,B,C,D,F,G	2,3,4,5
16	Cottonwood Cr. (tributary of Sand Coulee Cr.)	7	Missouri-Sun-Smith	A(C),P,R,1	IM,A	19.28 A,B,F	1,2
17	Uncle Sam Gulch blw Crystal Mine	3	Upper Missouri	A(C),P,R	1M	18.98 A,B,F	1
18	Muddy Creek (2)	24	Missouri-Sun-Smith	A(C),P,R,I	IA,N	18.77 A,B,C,D,F,G	2,6,7
19	Dry Fork Belt Cr.	12	Missouri-Sun-Smith	A(C),P	IM	17.80 A,B,F	1
20	Prickly Pear Cr. below Spring Cr. (2)	35	Missouri-Sun-Smith	A(C),P,R,1,L	1M,I,HM,1A,M,U,G, Helena WWTP, East Helena WWTP	17.09 A,B,C,D,F,G	1,2,3,5,6,7, 8
21	Silver Bow Cr. above Warm Springs Ponds (2)	23	Upper Clark Fork	A(C),P,R,L	Butte WWTP,1M,1, U,O	14.74 A,B,C,D,E,F	1,3,4,5,7,8
22	Hyalite Cr. below Forest Service Boundary	20	Upper Missouri	A(C),R	A,1A,O	14.22 A,B,F,G	2,5
23	Soda Butte Cr. below McLaren Tailings (2)	4	Upper Yellowstone	A(C),P	1M	12.70 B,D,E,F	1,5
24	Spring Cr. below Corbin Cr.	2	Missouri-Sun-Smith	A(C),P,R,1,L	1M	12.62 A,B,C,D,F	1
25	Blackfoot R. above Lincoln	24	Upper Clark Fork	A(C),P	IM	11 00 A,B,F	1
26	Spring Cr. below Ronan (tributary of Crow Cr.)	3	Lower Clark Fork	A(C),R,1	1A,O,U	10.67 A,B,F,G	2,5
27	Hot Springs Cr. below Hot Springs WWTP (2)	6	Lower Clark Fork	A(W),P,R	Hot Springs WWTP, N,G,A	10.17 B,F,G	2,3,5
28	Fool Hen Cr. (tributary of Virginia Cr.)	2	Missouri-Sun-Smith	A(C),P,L	1M	10.15 A,B,F	1
29	Snowshoe Cr.	5	Kootenai	A(C)	1M	9.32 B,F	1
30	Belt Cr. below Dry Fork Belt Cr.	60	Missouri-Sun-Smith	A(C),P,R,I,L	1M,A,F,WWTPs,O	8.89 B,F	1,2,3,5
31	Canyon Cr.	14	Upper Yellowstone	A(C),P,R,1	IA,N	8.82 B,F,G	2
32	Coller Gulch (Judith Mountains)	4	Musselshell	A(C),P,R,L	IM	8.73 A,B,F	1
33	Montana Gulch(Little Rocky Mtns.)	4	Middle Missouri	A(C),P	1M	8.66 A,B,F	1
34	Mason Gulch(North Moccasin Mtns.)	1	Middle Missouri	A(C),P	IM,M	8.34 B	1,5
35	Willow Cr. below Depot Cr.	20	Marias	A(C),P,R	Browning WWTP	8.26 B	3,5
36	Clark's Fork R. (2)	141	Upper Yellowstone	A(C),P,R,1	A,1A,N,1M	6.69 A,B,F	1,2
37	Godfrey Cr.	8	Upper Missouri	A(C),P,R	A,N	6.45 B,F	2,5
38	Beaver Cr. below Lake Bowdoin	40	Milk	A(W),P,R,1	HM,N,A	6.19 B,F,G	7
39	Cataract Cr. below Eva May Mine	5	Upper Missouri	A(C),P,R	1M	6.18 A,B,F	1
40	Virginia Cr. below Fool Hen Cr.	6	Missouri-Sun-Smith	A(C),P,L	1M	5.98 B	1
41	Teton R. below Muddy Cr. near Collins	124	Marias	P,1	1A,HM	5.96 A,B,F,G	7
42	Number Five Coulee (tributary of Sand Coulee Cr.)	6	Missouri-Sun-Smith	A(C)	1M,A	5.48 A,B,F	1,2
43	Beaver Cr. (2)	60	Little Missouri	A(W),P,R,1	A,Wibaux WWTP,N	5.12 B,F	2,3

Table 3-2 Continued

Map No (1)	Stream Segment (2)	Estimated Length (miles)	Basin	Probable Impaired Uses (3)	Pollution Sources (4)	Severity Index (5)		Control Programs (6)
44	Clark Fork R., Missoula WWTP to Champion International (2)	16	Lower Clark Fork	A(C),P,R	Missoula WWTP,U,D, plus sources in nos. 45,78 & 87	5.04	A,B,C,D,E,F	3,4,5,7
45	Clark Fork R., Warm Springs Cr. to Little Blackfoot R. (2)	38	Upper Clark Fork	A(C),P,R,I	WWTPs,IM,U,D, IA,I,G,F	4.86	A,B,C,D,E,F,G	1,2,3,4,5,7, 8
46	Redwater R. (2)	150	Lower Missouri	A(W),P,R,I	A,N	4.79	B,F	2
47	Chicago Gulch (Judith Mountains)	4	Musselshell	A(C),P,R	IM	4.54	A,B,F	1
48	Tenmile Cr.	12	Missouri-Sun-Smith	A(C),P,R	IM	4.22	B,F,G	1
49	Douglas Cr. at Philipsburg	5	Upper Clark Fork	P,I	IM	3.90	B,F	1
50	Careless Cr. below Deadman's Canal	8	Musselshell	A(W),P,I	IA,HM,N	3.74	A,B,F,G	7
51	Carpenter Cr. (tributary of Belt Cr.)	4	Missouri-Sun-Smith	A(C),P,R	IM	3.69	A,B,F	1
52	Silver Bow Cr. below Warm Springs Ponds (2)	1	Upper Clark Fork	A(C),P,R,I	Butte WWTP,IM,I, Anaconda WWTP,U,D	3.66	A,B,C,D,E,F	1,3,4,5,7,8
53	Armells Cr. (Judith Mountains)	5	Middle Missouri	A(C),P,R	IM	3.46	A,B,F	1
54	Bluewater Cr. below Orchard Canal (2)	3	Upper Yellowstone	A(C)	IA,HM,N	3.25	B,F,G	2,7
55	South Boulder R. below Mammoth	15	Upper Missouri	A(C),P,R	IM,M	3.24	B,F	1,5
56	Mission Cr.	18	Lower Clark Fork	A(C),P,R,I	IA,A,N	3.07	B,F,G	2
57	East Gallatin R. below Bozeman WWTP (2)	22	Upper Missouri	A(C),P,R	A,D,U,Bozeman WWTP	2.76	B,F,G	2,3,5
58	Poplar R. (2)	141	Lower Missouri	A(C),P,I	HM,A,N	2.61	B,E,F	2,7
59	Clancy Cr.	12	Missouri-Sun-Smith	A(C),P,R	IM,G	2.57	A,B,F	2,7
60	Musselshell R. below Deadman's Basin Reservoir Diversion (2)	309	Musselshell	A(W),P,R,I	A,IA,HM,C,G,N	2.43	B,F	2,7
61	Peoples Cr.	30	Milk	A(W),P,R,I	A,N	2.36	B	2
62	Post Cr. (tributary of Mission Cr.)	13	Lower Clark Fork	A(C),R,I	IA,A,N	2.31	A,B,F,G	2
63	Elk Cr. (tributary of Blackfoot R.)	12	Upper Clark Fork	A(C)	IM,M,G	2.07	B,F	2,5
64	Mill-Willow Bypass	4	Upper Clark Fork	A(C),P	IM,D	2.06	B,F	8
65	East Fork Poplar R. (2)	34	Lower Missouri	A(C),P,R,I	HM,A,N	2.06	B,E,F	2,7
66	Yellowstone R., Tongue R. to North Dakota Border (2)	160	Lower Yellowstone	A(W),P,R	IA,WWTPs,N	2.03	B,F	2,3,4,5
67	Crow Creek	12	Lower Clark Fork	A(C),R,I	IA,Ronan WWTP,A,N	1.99	B,F,G	2,3,5
68	Boulder R. below Basin (2)	45	Upper Missouri	A(C),R,P	IM,Boulder WWTP,IA, M,A,HM,C,N	1.88	B,F,G	1,2,3,5,7
69	Dry Fork Marias R. below Conrad WWTP	16	Marias	A(W),P,R	Conrad WWTP,N,A	1.70	B	2,3,5
70	Yellowstone R., Pryor Cr. to Tongue R.	165	Middle Yellowstone	A(W),P,R	WWTPs,I,IA,N	1.68	B,F	2,3,4,5
71	Bighorn R. below Yellowtail Dam (2)	70	Middle Yellowstone	A(C),P,R	HM,A,Hardin WWTP,N	1.65	B,F,G	2,3,5,7
72	Yellowstone R., Clark's Fork R. to Pryor Cr. (2)	30	Upper Yellowstone	A(C),P,R	Billings WWTP,IA, Laurel WWTP,I,U, Yegen Drain,D,N	1.53	A,B,C,D,F	2,3,4,5
73	Little Blackfoot R. (2)	39	Upper Clark Fork	A(C)	IM,IA,A,G,F	1.50	B,F	1,2
74	Sun R. below Muddy Cr. (2)	18	Missouri-Sun-Smith	A(W),P,R	IA,HM,N	1.48	A,B,C,D,F,G	2,6,7
75	Whitefish R. below Whitefish Lake (2)	19	Flathead	A(C),R	Whitefish WWTP, IA,U,D	1.45	A,B,C,D,F,G	2,3,5,6,7
76	Ashley Cr. above Kalispell WWTP (2)	20	Flathead	A(C),P,R	A,N	1.44	A,B	2
77	Silver Cr. (2)	22	Missouri-Sun-Smith	A(C),P	IM,M	1.30	B,F,G	1,5
78	Clark Fork R., Blackfoot R. to Missoula WWTP (2)	10	Lower Clark Fork	A(C),P,R	Milltown Reservoir, U,D,plus sources in nos. 45 and 87	1.22	A,B,C,D,E,F,G	1,4,5,7,8
79	Beaverhead R. (2)	35	Upper Missouri	A(C),P,R,I	IA,Dillon WWTP,HM	1.21	B,F,G	2,3,5
80	Missouri R.blw.Fort Peck Dam(2)	185	Lower Missouri	A(W),P,R,I	HM,A,N	1.16	B,F	2
81	Lump Gulch Cr.	13	Missouri-Sun-Smith	A(C),P	IM	1.09	A,B,F,G	7
82	Missouri R. above Canyon Ferry Reservoir	41	Missouri-Sun-Smith	A(C),P,R	IA,WWTPs,N	1.06	B,D,F	2,3
83	Stillwater R. below Logan Cr.(2)	31	Flathead	A(C),R	IA,A,F,D,U, Whitefish WWTP	0.96	A,B,C,D,F,G	2,3,5,6,7

Table 3-2 Continued

Map No. (1)	Stream Segment (2)	Estimated Length (miles)	Basin	Probable Impaired Uses (3)	Pollution Sources (4)	Severity Index (5)	Control Programs (6)
84	Clark Fork R., Champion International to Huson (2)	9	Lower Clark Fork	A(C),P,R	Champion Paper Mill, Missoula WWTP plus sources in nos. 44, 45, 78 and 87	0.95 A,B,C,D,E,F	3,4,5,7
85	Clark Fork R., Huson to Flathead R. (2)	85	Lower Clark Fork	A(C),P,R	Same as sources in nos.44,45,78,84 & 87	0.93 A,B,C,D,E,F	1,2,3,4,5,7, 8
86	Little Peoples Cr. (Little Rocky Mountains)	20	Milk	A(C),P	IM,G	0.93 B,D,F	1,2
87	Clark Fork R., Little Blackfoot R. to Blackfoot R.(2)	81	Upper Clark Fork	A(C),P,R	N,HM plus sources in no. 45	0.86 A,B,C,D,E,F,G	1,2,3,4,5,8
88	Milk R. below Fresno Dam (2)	437	Milk	A(W),P,R,L	IA,WWTPs,N	0.79 A,B,F	2,3
89	Big Spring Cr. below Lewistown WWTP (2)	17	Middle Missouri	A(C),R	Lewistown WWTP, A,HM	0.72 B,D,F	2,3,5
90	Missouri R., Canyon Ferry Dam to Sun R. (2)	132	Missouri-Sun-Smith	A(C),P,R	HM,A	0.63 B,C,D,F	2
91	Missouri R., Sun R. to Fort Peck Reservoir (2)	223	Middle Missouri	A(W),P,R	IA,WWTPs,N	0.63 B,C,F	2,3
92	Flint Cr.	44	Upper Clark Fork	A(C),P	IM,IA	0.62 B,F	2,4
93	Clark Fork R., Flathead R. to below Cabinet Gorge Dam (2)	100	Lower Clark Fork	A(C),P,R	Same as sources in nos. 44,45,78,84 & 87 plus Thompson Falls, Noxon & Cabinet Gorge Reservoirs	0.55 A,B,C,D,E,F,G	1,2,3,4,5,7, 8
94	Marias R. below Pondera Coulee	74	Marias	P,R	A,N	0.54 B,F	2
95	Pondera Coulee	77	Marias	I	A,N	0.52 A,B	2
96	Basin Cr.	12	Upper Missouri	A(C)	IM	0.52 A,B	1
97	Yellowstone R. above Clark's Fork R. (2)	190	Upper Yellowstone	A(C),R	IM,A,F,G,N	0.48 B,F	1,2,4,7
98	Grasshopper Cr. below Bannack(2)	18	Upper Missouri	A(C)	IM,G	0.28 B,F,G	1,2
99	Warm Springs Cr. below Anaconda	7	Upper Clark Fork	A(C),P,R	IM	0.27 B,F	8
100	Bitterroot R. (2)	80	Lower Clark Fork	A(C),P	IA,HM,O	0.24 B,C,F	2,5,7
101	Fisher R. (2)	64	Kootenai	A(C)	HM,C,F,A	0.24 B,F	2
102	Little Bighorn R.	116	Middle Yellowstone	A(C)	A	0.11 B,F	2
103	Two Medicine R. below Badger Cr.	30	Marias	A(C)	IA,A	0.09 B,F	2
104	Madison R. below Ennis Lake (2)	40	Upper Missouri	A(C)	HM,IA	0.08 B	2,7
105	Daisy Cr. below McLaren Mine	3	Upper Yellowstone	A(C)	IM	(7) A,B,F	1
106	Stanley Cr. (2)	3	Kootenai	A(C)	M	(7) A,B,F	5
107	Big Hole R. below Melrose (2)	39	Upper Missouri	A(C)	IA	(7) B,D,F	2
		4662					

(1) Problem segments are mapped in Figure 1.

(2) Impairment of aquatic life in the problem segment has been confirmed by a biological survey.

(3) A(C) = Aquatic life (cold water)
A(W) = Aquatic life (warm water)
P = Public Water supply
R = Primary contact recreation
I = Irrigation
L = Livestock watering

(4) A = Agriculture (multiple practices)
C = Construction
F = Forest practices
G = Grazing
HM = Hydrologic modification
I = Industrial discharge
IA = Irrigated agriculture
IM = Inactive mining
M = Mining
N = Natural
O = Onsite domestic waste disposal
U = Urban runoff
WWTP = Wastewater treatment plant

(5) A = Downstream use(s) impaired
B = Improved water quality attainable
C = Large population affected
D = Valued resource affected
E = Interstate, national or international issue
F = Local interest and involvement
G = Unnatural flow fluctuation

(6) 1 = Abandoned mine land reclamation program (DSL and OSM)
2 = Agricultural conservation programs (SCS, ASCS, CES, DNRC, County Conservation Districts, Ag. Experiment Station)
3 = Construction grants program (DHES and EPA)
4 = Instream flow reservations (DHES and DFWP)
5 = MPDES permits and enforcement program (DHES and EPA)
6 = Renewable resource development program and water development program (DNRC)
7 = Special water quality improvement projects
8 = Superfund

(7) Excursions from criteria have been documented using data that are not on STORET

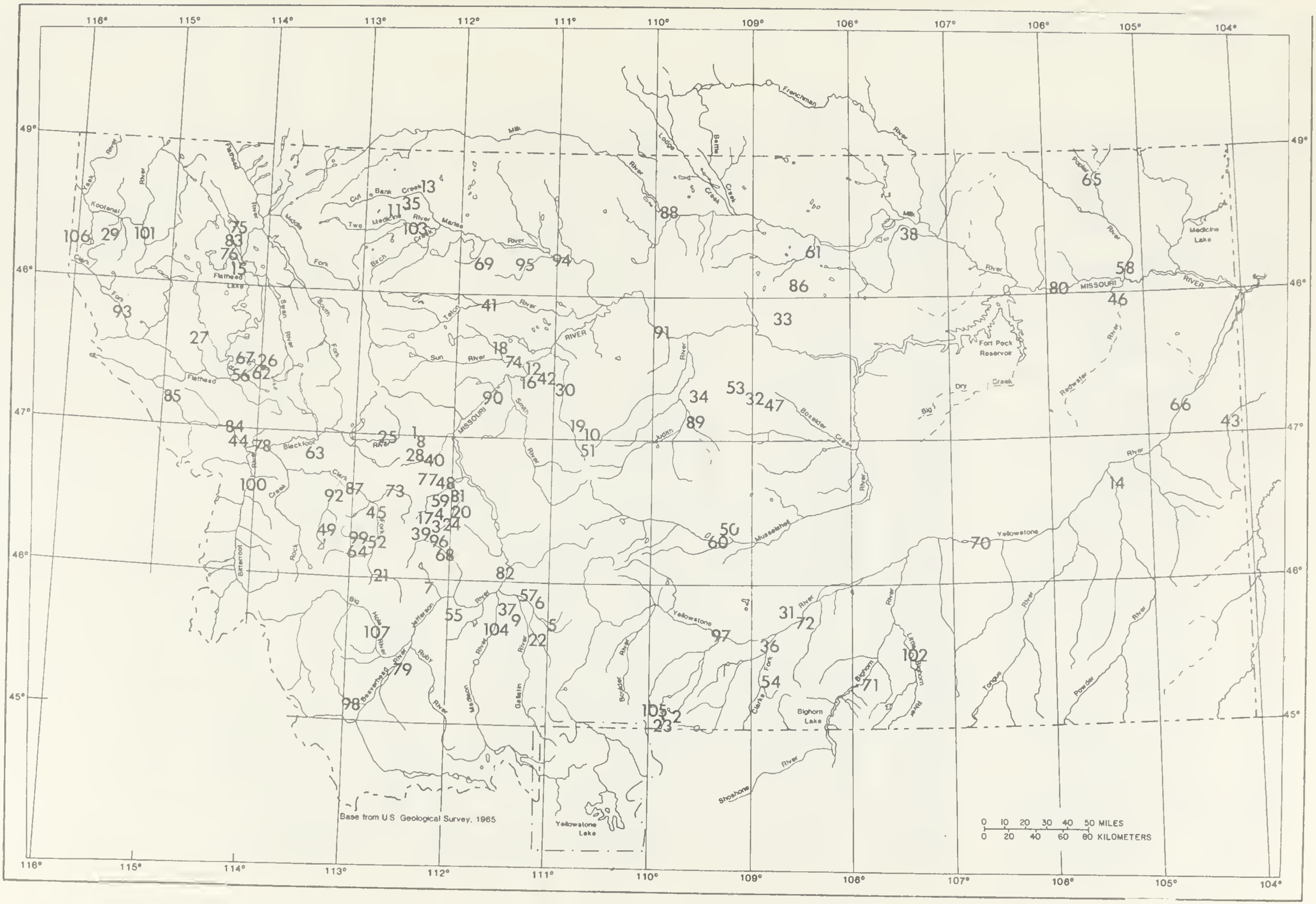


Figure 3-1 Montana stream segments having predominantly man-caused water quality problems

Because problems in these streams are predominantly man-caused, they have the greatest potential for improving from pollution control efforts.

Many additional stream segments totaling thousands of stream miles are thought to be affected by land-use practices, but do not have recent data on STORET that can be used to validate use impairment. Most of these segments were identified during the ASIWPCA nonpoint source assessment and are listed in Table 6-11. The DHES will attempt to document the extent and severity of impairment in these segments as resources allow.

3.1.1.3. CONTROL EFFORTS

The problems in Table 3-2 are collectively being addressed by eight programs and program areas that could effect significant water quality improvements.* Efforts are at various stages of planning and implementation. These programs and program areas are:

Abandoned Mine Land (AML) Program Funded by a fee on coal production and administered by the U.S. Office of Surface Mining (OSM) through the Montana Department of State Lands (DSL), the AML program achieves reclamation of inactive mining areas that pose a threat to public health and safety.

Agricultural Conservation Programs. Included under this rather large umbrella are a number of cost-share, technical assistance, research and educational programs sponsored by the Soil Conservation Service (SCS), Agricultural Stabilization and Conservation Service (ASCS), Cooperative Extension Service (CES), Department of Natural Resources and Conservation (DNRC), county conservation districts and the Montana Agricultural Experiment Station. Important among these are the Agricultural Conservation Program and the Conservation Reserve Program of the ASCS and the Small Watershed and Great Plains Conservation programs of the SCS. In certain areas of central Montana, the Montana Salinity Control Association, a consortium of county conservation districts, may help to alleviate groundwater and surface water salinity problems.

Construction Grants Program. The EPA will share the cost of planning, designing and constructing municipal wastewater treatment systems where upgrading is required to meet minimum treatment standards or where a public health or water quality problem exists. Responsibility for administering this program in Montana has been delegated to the DHES (See Section 6.1.1.). Construction grants projects are active on a majority of problem segments in Table 3-2 that are affected by municipal wastewater discharges.

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* Table 6-13 contains a descriptive listing of nonpoint source control programs in Montana.

Instream Flow Reservation. The 1973 Montana Water Use Act, administered by the DNRC, provides for reservations of instream flows by public agencies for beneficial uses, which include water quality and fish habitat. In 1978, the DHES successfully defended a request for and received a reservation of flows in the Yellowstone River for the purpose of maintaining sulfate and salinity at levels suitable for human consumption. The DFWP has prepared an application for an instream flow reservation in the Clark Fork River, which includes problem segments that may benefit from guaranteed minimum flows. In addition, the DFWP has purchased water to insure a minimum flow in Ashley Creek near Kalispell and is negotiating with the Montana Power Company to purchase water from Painted Rocks Reservoir to bolster flows in the Bitterroot River.

MPDES Permits and Enforcement Program. The Montana Pollutant Discharge Elimination System (MPDES) is administered by the DHES for the purpose of controlling the discharge of pollutants from point sources into state waters. (See Section 6.1.3.) A number of the problem segments in Table 3-2 are affected by point source discharges, mostly from municipal wastewater treatment plants that are in the process of upgrading their facilities and the quality of their effluents. Where municipal effluents are concerned, the permits program works hand-in-hand with the construction grants program to ensure compliance with permit limits and water quality standards. Enforcement of water quality laws and rules applies to certain nonpoint source activities as well as to permitted and unpermitted discharges.

Renewable Resource Development (RRD) Program/Water Development Program. The RRD program began in 1975 when the legislature voted to use a portion of the state's coal severance tax revenues to protect and develop Montana's renewable resources. The program provides grants and loans to agencies of state or local government for a variety of purposes, including soil and water conservation. The Water Development Program was created by the 1981 Legislature and funded by coal tax revenues to help finance public and private water development projects and activities. Eligible projects include irrigation system repair, saline seep abatement, canal lining, streambank stabilization and erosion control. Both programs are administered by the DNRC. A number of current, special water quality improvement projects on problem segments in Table 3-2 have been funded by the RRD and Water Development programs.

Special Water Quality Assessment and Improvement Projects. This is a catchall category of pollution control efforts at the local, problem-specific level. Included are a number of special water quality management planning studies of priority water bodies. Some of these local efforts have been funded by the RRD and Water Development Programs, 208 and 205 (j) water quality management planning grants, and other state and federal resource conservation programs.

Superfund. The Superfund was set up by Congress and the EPA in 1980 to finance the cleanup of hazardous waste disposal sites that pose a threat to public health. Montana contains numerous existing and candidate sites for Superfund cleanup. Of these, four are located on

problem segments in Table 3-2: 1) the Anaconda Reduction Works at Anaconda, 2) Silver Bow Creek between Butte and Deer Lodge, 3) Milltown area groundwater near Missoula, and 4) the ASARCO smelter at East Helena. The Silver Bow Creek project has the largest potential to actually improve water quality in Silver Bow Creek and the Clark Fork River.

A large number of local, state, federal and Indian agencies also carry out water pollution control programs. (See Table 6-13.) Notable among these are programs administered by the Montana Reclamation Division, DSL, the U.S. Forest Service (USFS) and Bureau of Land Management (BLM), and county soil and water conservation districts. Although these programs may not be singularly important in correcting the problems noted in Table 3-2, they are extremely important at holding the line against pollution in countless other stream segments

3.1.2. LAKES AND RESERVOIRS

There are approximately 4,018 lakes, reservoirs and ponds in Montana comprising about 756,450 acres. Montana's computerized lake data file contains information on 1,984 lakes (the file does not distinguish between lakes, reservoirs and ponds). Surface area is given for 1,880 lakes in the data file, which total 663,363 acres ("acres assessed"). Lakes not in the data file are primarily remote mountain lakes, some of which are barren of fish, and lakes and farm ponds without public access.

During 1984 and 1985, 18 lakes with a total area of about 180,000 acres were monitored. Of these, Flathead Lake (126,000 acres) was monitored most thoroughly. (See Section 6.4.2.) Flathead Lake has been the object of considerable attention aimed at slowing the lake's accelerating rate of eutrophication. (See also sections 5.1., 6 5.1 and 6.5.2.) Whitefish Lake (3,350 acres) has been monitored under the auspices of the Whitefish County Water and Sewer District, which has also investigated septic leachates, conducted land suitability analyses, and prepared a water quality management plan for the Whitefish Lake drainage. Monitoring of other lakes included 14 lakes (4,340 acres) surveyed by Lincoln County personnel and monitoring of toxic algae blooms on Canyon Ferry and Hebgen reservoirs (total area 47,000 acres) by DHES personnel and others.

Four lakes with a total area of 13,250 acres do not support their designated uses and eight lakes with a total area of 20,595 acres only partially support their designated uses (Table 6-12 and Figure 3-2). The lakes that do not support their designated uses are affected primarily by natural salinity, although they also receive saline water from dryland and irrigated farming areas. (See also Section 3.1 3 for a discussion of these lakes, which are used principally as waterfowl production areas.) The lakes that are partially supporting their designated uses are all affected by nonpoint sources of pollution, and some natural pollution. The remaining 1,972 lakes and 629,518 acres assessed all support their designated uses.

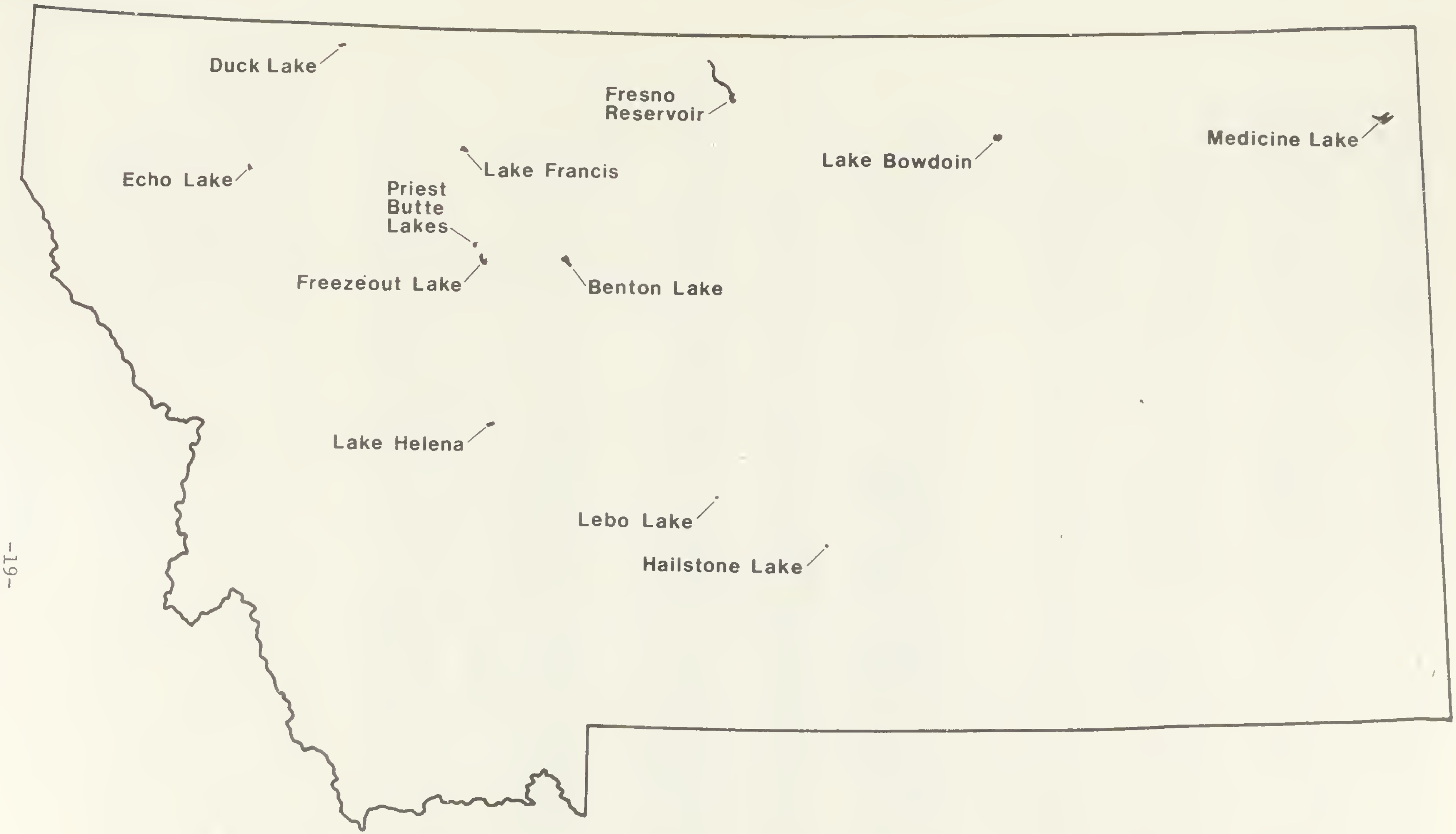

Figure 3-2 Montana lakes that do not fully support their designated uses

All 1,984 lakes and 663,363 acres assessed meet the "swimmable" goal of the federal Clean Water Act while 1,980 lakes and 650,113 acres meet the "fishable" goal. The four lakes and 13,250 acres that are naturally saline and do not support their designated uses do not, and probably never will, meet the fishable goal of the Clean Water Act. The status of the remaining 93,087 acres of unassessed lakes and ponds is unknown, although most probably do meet both the fishable and swimmable goals.

Of the 663,363 acres assessed, about 134,000 acres are classified as A-closed or A-1 waters by the Montana Surface Water Quality Standards. (See Chapter 2. Background) These waters are designated for uses more stringent than fishing and swimming.

Of the 1,880 lakes with surface area available in the data file, 1,378 lakes totalling 643,146 acres have been assessed as to trophic status (Table 3-3).

3.1.3. WETLANDS

Wetlands are areas saturated by surface or ground water that support vegetation typically adapted for life in wet soils. They include swamps, marshes, bogs, sloughs, potholes, wet meadows, river overflows, mud flats and natural ponds.

Montana wetlands are important resources. They provide habitat for wildlife--particularly nesting, rearing and resting sites for migratory waterfowl. Wetlands produce food for animals in both the wetland and adjacent terrestrial communities. They control floods by retaining water during periods of high runoff, then releasing it gradually. Many ground water aquifers are fed by wetland recharge. Wetlands also serve as nutrient traps, chemical sinks, erosion barriers and sedimentation basins, thereby improving water quality.

Concerns regarding wetland water quality result from the haphazard use of pesticides and herbicides and increasing salinity from poor agricultural practices. Livestock watering in wetland areas have been poisoned by the toxic elements and saline water. Elevated salinity in the Benton Lake National Wildlife Refuge near Great Falls has been coincident with an increase in botulism among waterfowl.

Relatively little information is available regarding water quality in Montana wetlands. This is probably because the principal use of wetlands is for wildlife habitat and the water quality of most Montana wetlands has not been shown to impair this use.

Recently, Montanans became concerned with the contamination of some wetlands from naturally occurring selenium and other toxic elements. These concerns first surfaced when articles published by the Sacramento Bee newspaper in September 1985 (and later reprinted in state newspapers) reported findings of selenium in water, sediment, algae and plant material at 23 sites in nine western states. Many of the sites were in or near U.S. Bureau of Reclamation irrigation projects and national wildlife refuges. The Montana sites included Benton Lake National Wildlife Refuge, Lake Bowdoin National Wildlife Refuge, the

Table 3-3. Trophic status of Montana lakes. Source: Montana Department of Fish, Wildlife and Parks Lakes File, April 18, 1986.

Trophic Status	Number of Lakes	Acres
Oligotrophic (1)	452	254,692
Mesotrophic (2)	428	348,522
Eutrophic (3)	371	39,262
Dystrophic (4)	127	670
Unknown (5)	502	20,217

(1) Oligotrophic Lake: Nutrient poor, oxygen rich, depth usually greater than 25 feet, bottom material mostly inorganic, dissolved oxygen plentiful at bottom, emergent aquatic plants absent, total dissolved solids less than 30 ppm, plankton scarce.

(2) Mesotrophic Lake: Attributes intermediate between those for oligotrophic and eutrophic lakes, the depth usually greater than 20 feet.

(3) Eutrophic Lake: Usually 10-25 feet deep, bottom material mostly organic, dissolved oxygen often absent at bottom, emergent aquatic plants present, total dissolved solids more than 30 ppm, plankton abundant.

(4) Dystrophic Lake: Includes bog lakes, depth less than 20 feet, characterized by incomplete decay of plants, accumulation of humic materials, bottom material entirely organic, water saturated with dissolved oxygen during daylight hours, below saturation at night, emergent aquatic plants and plankton abundant.

(5) Unknown Lakes: Lakes in the data file with surface area available that have not been assessed as to trophic status. Two additional lakes have trophic status but not acreage: one is oligotrophic and one is mesotrophic.

Fairfield Bench irrigation project, Freezeout Lake and the Huntley irrigation project (Figure 3-3).

In response to the assertions published in the Sacramento Bee, the U.S. Department of Interior (DOI) proposed studies to evaluate the extent of contamination by selenium and other toxic constituents at Benton Lake, Freezeout Lake (see Section 5.7.), Lake Bowdoin and the Fairfield Bench. Preliminary information showed little reason for concern at the Huntley irrigation project. Final plans for the DOI studies, however, had not been made at press time.

The DOI studies are expected to include field sampling and analysis of water, sediment and plant and animal tissue for a variety of toxic contaminants. The objective will be to determine whether water from irrigation has impaired, or has the potential to impair, human health, fish and wildlife and other water uses. If preliminary information indicates an existing or high potential for harmful effects, more detailed investigations will be done to determine the extent, magnitude and cause of the harmful effects.

The DOI studies will provide important information, but the actual loss or destruction of wetlands continues to be the main concern.

The U.S. Fish and Wildlife Service (USFWS) is conducting a nationwide inventory of wetlands. It will expand a partial survey done in the 1950's. The earlier survey was confined to the 15 northern Montana, or "Hi-line", counties and a portion of Lake County.

The earlier study estimated Montana had 187,400 acres of wetlands, or approximately two-tenths of one percent of the state's area. The latest National Wetlands Inventory is expected to provide greater detail and a more accurate assessment of the quantity and quality of wetlands in Montana. Maps will be prepared to show the location of wetlands. The inventory will identify each area according to the USFWS classification system. Only about two percent of the state has been mapped to date. The inventory has not progressed in Montana since 1982 due to funding limitations and drought.

Without information from the wetlands inventory it is difficult to assess the status of Montana's wetlands; however, it appears they are being lost to development. The actual rate and significance of the losses cannot be measured until the information is gathered.

State and federal agencies will continue to work together to protect Montana wetlands. A two-day Montana wetlands workshop is planned for June 1986. This workshop is intended to raise the level of awareness of Montana's federal and state workers regarding the values of wetlands and the need for wetland protection.

The programs of several agencies that have impacts on wetlands include:

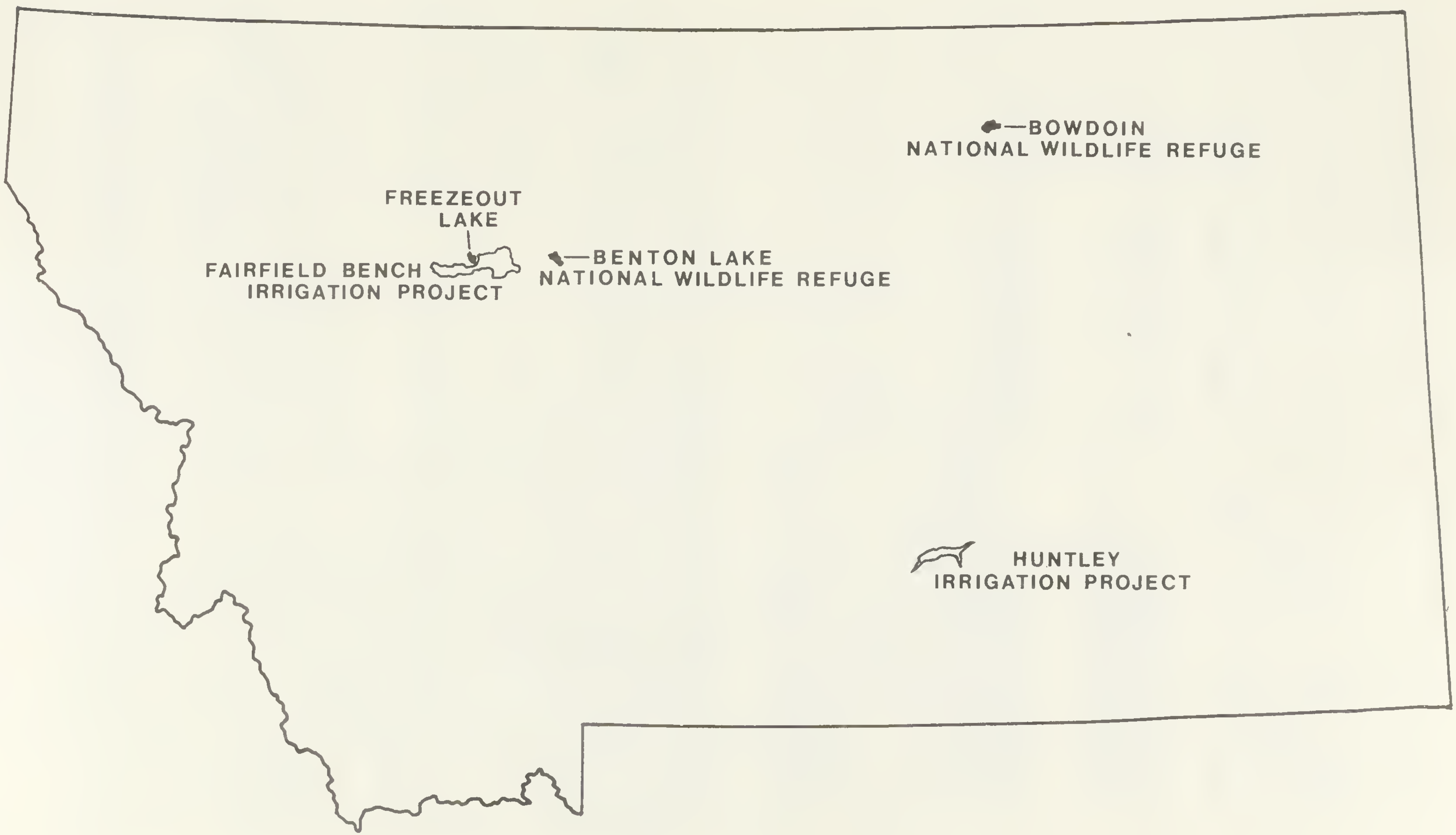

Figure 3-3 Sites in Montana investigated for selenium contamination by the Sacramento Bee.

Bureau of Land Management	Grazing and land exchange
Forest Service	Logging, grazing and road building
Department of Highways Federal Highway Administration	Road construction and maintenance
Department of State Lands	Logging, grazing and mining
Bureau of Reclamation Department of Natural Resources and Conservation	Water resource development
Conservation Districts Extension Service Agricultural Stabilization and Conservation Service (ASCS) Soil Conservation Service	Agricultural activities and agricultural program implementation
U.S. Fish and Wildlife Service Department of Fish, Wildlife and Parks (DFWP)	Wetland refuge management

Executive Order 11990 ("Protection of Wetlands") requires all federal agencies to minimize the loss, destruction and degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. In addition, the U.S. Fish and Wildlife Coordination Act requires all federal agencies to consult with the USFWS and the DFWP whenever federal activities are proposed that impact fish and wildlife resources, including wetland habitat.

The U.S. Army Corps of Engineers administers the Dredge and Fill Permit Program in Montana under Section 404 of the U.S. Clean Water Act. This program regulates the proposed destruction and filling of wetland areas. The Corps stationed field representatives in Helena and Billings in 1984 to improve the administration of the program. A greater focus on enforcement is expected.

The USFWS, in addition to managing several wetland wildlife refuges, also administers a wetlands acquisition program whereby important and threatened wetlands can be obtained through perpetual easement or direct purchase. In 1982, more than 22,000 acres were acquired in 22 Montana counties. Funding, however, has been reduced. In 1984 and 1985, 1,962 wetland acres were acquired by purchase and 227 acres by easement. Most of the recent acquisition occurred in northeastern Montana.

The ASCS of the U.S. Department of Agriculture administers the Water Bank Program whereby private landowners enter into 10-year

agreements not to destroy selected wetlands in return for annual payments. Nine counties (Daniels, Glacier, Lake, Pondera, Sheridan, Toole, Roosevelt, Flathead and Teton) offer or have offered Water Bank agreements. Approximately 3,000 acres of Montana wetlands have been protected through this program. No new agreements have been signed since 1982, but several have been renewed. The program is presently threatened by budget cutbacks.

The 1985 Farm Bill includes a wetland conservation provision that eliminates U.S. Department of Agriculture (USDA) agricultural program subsidies to persons converting wetlands to agricultural production. This provision is frequently referred to as the "swampbusting" provision.

The DFWP administers 45 wildlife management areas. Nineteen of these areas contain wetlands. The DFWP also has been assisting the USFWS with the National Wetlands Inventory, particularly with verification and analysis of wetlands identified in aerial photos.

The Bureau of Land Management (BLM), U.S. Department of Interior, manages more than eight million acres of land in Montana. The BLM estimates that its land contains approximately 33,000 acres of marshes, wet meadows and seeps, 143,000 acres of riparian areas and 15,600 acres of lakes and ponds. The BLM has filed for water rights on more than 4,300 pothole areas under their jurisdiction in northeastern Montana.

Finally, the Montana Natural Streambed and Land Preservation Act requires private parties to obtain permits from local conservation districts for stream construction activities. Similarly, the Montana Stream Protection Act requires state and local governmental entities to obtain permits from the DFWP. Neither of these state programs, however, extends regulatory protection to wetland areas such as marshes, bogs, potholes and ponds. The focus for wetland protection under Montana state government is unclear. Efforts are being made, however, to improve interagency coordination and clarify roles and responsibilities.

3.2. TRENDS

A sufficient amount of monitoring information is available for trend analysis at 24 water quality stations in Montana (Figure 3-4). All but one of these stations -- the Clark Fork River at Deer Lodge -- are operated by the U.S. Geological Survey as part of the National Stream Quality Accounting Network (NASQAN) and other long-term monitoring programs. (The NASQAN station on the Missouri River at Virgelle -- No. 06109500 -- recently has been moved to Fort Benton -- No. 06090800.) The Clark Fork River station at Deer Lodge is the DHES' principal water quality station on the upper river, and the only long-term water quality station in Montana operated exclusively by the state.

At the Deer Lodge station, samples for an array of water quality variables were collected sporadically from 1974 through 1977 and monthly since 1978. (See Section 6.4.1 for detailed information on the DHES Clark Fork River water quality monitoring program.)

Figure 3-4. Water quality trend stations in Montana

Trends in water quality variables were ascertained at these 24 stations using a trend analysis program developed and run by the Data Analysis Branch of the Region VIII Office of the EPA (Table 3-4). The program compares median values for selected portions of the period of record and determines whether they are significantly different at the 95 percent level of probability. For this year's analysis, the period of record was split in half and the first-half data compared to the last-half data. (If the period of record is an odd number of years, the odd or extra year was placed in the first half.) To achieve a finer resolution of trends, the data were compared by quarter or season (Season 1 = January-March, etc.).

The concentrations of many variables are influenced by the amount of precipitation, runoff and streamflow. In drainages where nonpoint sources of pollution are important -- which is practically every drainage in Montana -- these factors influence water quality a great deal. A concurrent analysis of trends in streamflow may go a long way toward explaining some of the water quality trends in Table 3-4. Such an analysis is planned for the 1988 305(b) Report, when Montana will join other states in a six-year retrospective look at changes in water quality.

Plots of data collected over the last 12 years at the Deer Lodge station have been prepared to more clearly visualize trends in selected water quality variables (Figures 3-5 through 3-10). The plots for copper and zinc (Figures 3-5 and 3-6) show seasonal pulses in concentration associated with spring snowmelt runoff. Plots for other heavy metals show a similar pattern. Based on information not presented here, the size of these spring peaks appears to be a function of the magnitude and intensity of the snowmelt runoff and the amount of suspended sediment carried by the river. Much of the metals in the upper Clark Fork drainage is of nonpoint origin and associated with streambed sediments. Although the EPA trend analysis (Table 3-4) indicated that the median values for copper, maganese and iron were significantly lower over the second half of the period of record (since 01/01/80), this was only true for data collected during the first quarter (Jan.-Mar.)

Hardness and sulfate concentrations at Deer Lodge have declined steadily since 1980 (Table 3-4 and Figures 3-7 and 3-8). The secondary drinking water standard for sulfate is 250 mg/l, a level that has not been exceeded since 1981. As hardness decreases, the toxicity of heavy metals such as copper increases. Hence a reduction in hardness without a proportional reduction in heavy metals would render the remaining metals relatively more toxic. Decreases in sulfate and hardness, along with the baseflow decline in copper and other heavy metals, may reflect refined wastewater treatment by the Anaconda Company in the early 1980's followed by cessation of Anaconda operations in 1983, a reduction of lime applications at the Warm springs Ponds, and (or) a gradual "cleansing" of contaminants from the stream channel by successive runoff events.

Nutrients at the Deer Lodge station exhibit seasonal concentration patterns (Figures 3-9 and 3-10), but, except for total ammonia (Table

Table 3-4. Water quality trends at long-term monitoring stations in Montana.

Agency Code	Station Number	Station Name	Pivotal Date(1)	Parameters Increased	Season(s) (2)	Parameters Decreased	Season(s) (2)
112WRD	06294700	Bighorn River at Bighorn	01/01/73	pH	1,2,3,4	Dissolved Solids	1,3,4
						Conductivity	1,3,4
						Sodium	1,3,4
						SAR	1,3,4
						Iron	1
						Suspended Sediment	2,3,4
						Temperature	2
						Sulfate	3,4
						Hardness	3,4
						Chloride	4
21MTHDWQ	3526CL01	Clark Fork River at Bridge above Deer Lodge	01/01/80	None		Total Ammonia	1
						Dissolved Solids	1,4
						Conductivity	1,2,4
						Sulfate	1,4
						Iron	1
						Manganese	1
						Copper	1
						Hardness	1,2,3,4
112WRD	12353000	Clark Fork River below Missoula	01/01/82	Dissolved Oxygen	3	Dissolved Solids	1
						Sulfate	1,3,4
						Sodium	1
						Temperature	2
						Conductivity	3
112WRD	06178500	East Poplar River at International Boundary	01/01/79	None		None	
112WRD	12355000	Flathead River at Flathead, British Columbia	01/01/76	Conductivity	3,4	Total Phosphorus	3
				Sulfate	4	Chloride	4
112WRD	12363000	Flathead River at Columbia Falls	01/01/68	pH	1,2,3,4	Chloride	1,3,4
				Iron	2	Sodium	1,2,3,4
						Dissolved Solids	2
						Conductivity	2,4
						Hardness	2

Table 3-4 Continued

Agency Code	Station Number	Station Name	Pivotal Date(1)	Parameters Increased	Season(s) (2)	Parameters Decreased	Season(s) (2)
112WRD	12301933	Kootenai River below Libby Dam near Libby	01/01/75	pH	1,3,4	Dissolved Oxygen	1,2,3,4
				Temperature	1	Nitrite plus Nitrate	1,2,3
				Chloride	2,3	Total Ammonia	1,2
						Total Phosphorus	1,2,3,4
						Dissolved Solids	1,4
						Conductivity	1,2,4
						Chloride	1,4
						Sulfate	1,4
						Magnesium	1,4
						Sodium	1,4
						Iron	1,2,4
						Zinc	1,2,3,4
						Hardness	1,4
						Temperature	2
						Manganese	3
112WRD	06101500	Marias River near Chester	01/01/75	Dissolved Solids	1,3	Temperature	3,4
				Chloride	1,2		
				Sulfate	1,2		
				Sodium	1,2		
				SAR	1,2,3,4		
				pH	1,2,3,4		
				Conductivity	3		
112WRD	06174500	Milk River at Nashua	01/01/73	Conductivity	2,4	Iron	2,3
				Magnesium	2,3,4		
				Sodium	2,3,4		
				pH	2,3,4		
				Dissolved Solids	3		
				Sulfate	3,4		
				SAR	4		
112WRD	06054500	Missouri River at Toston	01/01/76	Chloride	4	Zinc	2
				pH	4	Temperature	3
112WRD	06109500	Missouri River at Virgelle	01/01/80	Total Ammonia	2	Fecal Coliforms	1
				Dissolved Oxygen	3	Iron	3
						Dissolved Solids	4
						Conductivity	4

Table 3 4. Continued

Agency Code	Station Number	Station Name	Pivotal Date(1)	Parameters Increased	Season(s) (2)	Parameters Decreased	Season(s) (2)
112WRD	06115200	Missouri River near Landusky	01/01/79	None		Suspended Sediment	1,3
						Iron	4
112WRD	06132000	Missouri River below Fort Peck Dam	01/01/80	Dissolved Solids	1,2,4	Mercury	2
				SAR	1	Iron	4
				Hardness	1		
				Chloride	2,3		
				Temperature	3		
				pH	3		
				Hardness	3		
112WRD	06185500	Missouri River near Culbertson	01/01/75	Dissolved Solids	1,2,3,4	Total Phosphorus	2,3,4
				Conductivity	1,2,3,4	Temperature	3
				Sulfate	1,2,3,4	Suspended Sediment	4
				Magnesium	1,3,4		
				Sodium	1,2,3,4		
				SAR	1,3,4		
				pH	1,2,3,4		
				Hardness	1,2		
				Chloride	2,3		
112WRD	06130500	Musselshell River at Mosby	01/01/80	Conductivity	2	Fecal Coliforms	1,3
				Nitrite plus Nitrate	3	Mercury	2
				Total Ammonia	3		
				pH	3		
				Chloride	4		
				Sodium	4		
112WRD	06178000	Poplar River at International Boundary	01/01/80	None		None	
112WRD	06326500	Powder River near Locate	01/01/73	Sodium	1	Conductivty	3
				SAR	1,2	Sulfate	3,4
				pH	1,2,3,4	Hardness	3,4
112WRD	05020500	St.Mary River at International Boundary	01/01/82	Temperature	3	Conductivity	3
						Iron	4
112WRD	06306300	Tongue River at State Line near Decker	01/01/76	Hardness	1	pH	1
				Iron	2	Sulfate	3,4
				pH	2,3,4	Iron	3,4
				Total Phosphorus	4	Magnesium	4

Table 3-4 Continued

Agency Code	Station Number	Station Name	Pivotal Date(1)	Parameters Increased	Season(s) (2)	Parameters Decreased	Season(s) (2)
112WRD	06307500	Tongue River at Tongue River Dam	01/01/81	Suspended Sediment	1	Conductivity	1
				Nitrite plus Nitrate	3	Sulfate	4
				Total Ammonia	3	Iron	4
112WRD	06308500	Tongue River at Miles City	01/01/73	pH	2,3,4	Iron	2
						Conductivity	3
112WRD	06192500	Yellowstone River near Livingston	01/01/76	Dissolved Solids	1,3	None	
				Chloride	1,3,4		
				SAR	1		
				pH	1		
				Conductivity	3		
				Sulfate	3,4		
				Magnesium	3		
				Sodium	3,4		
				pH	3,4		
				Hardness	3		
112WRD	06214500	Yellowstone River at Billings	01/01/75	Conductivity	1	None	
				Chloride	1,3,4		
				Sulfate	1		
				Sodium	1		
				Temperature	1,4		
				pH	1,2,3,4		
				Dissolved Solids	4		
112WRD	06329500	Yellowstone River near Sidney	01/01/75	Chloride	1	Fecal Coliforms	1
				pH	1,2,3,4	Temperature	1
				Manganese	2	Total Ammonia	2,4
						Total Phosphorus	4
						Suspended Sediment	4

(1) The "pivotal date" is roughly the midpoint of the period of record for water quality measurements at the station in question. Data collected before this date are compared with data collected after this date. If the period of record is an odd number of years, the odd or extra year was placed in the first half

(2) Season 1 = January - March
Season 2 = April - June
Season 3 = July - September
Season 4 = October - December

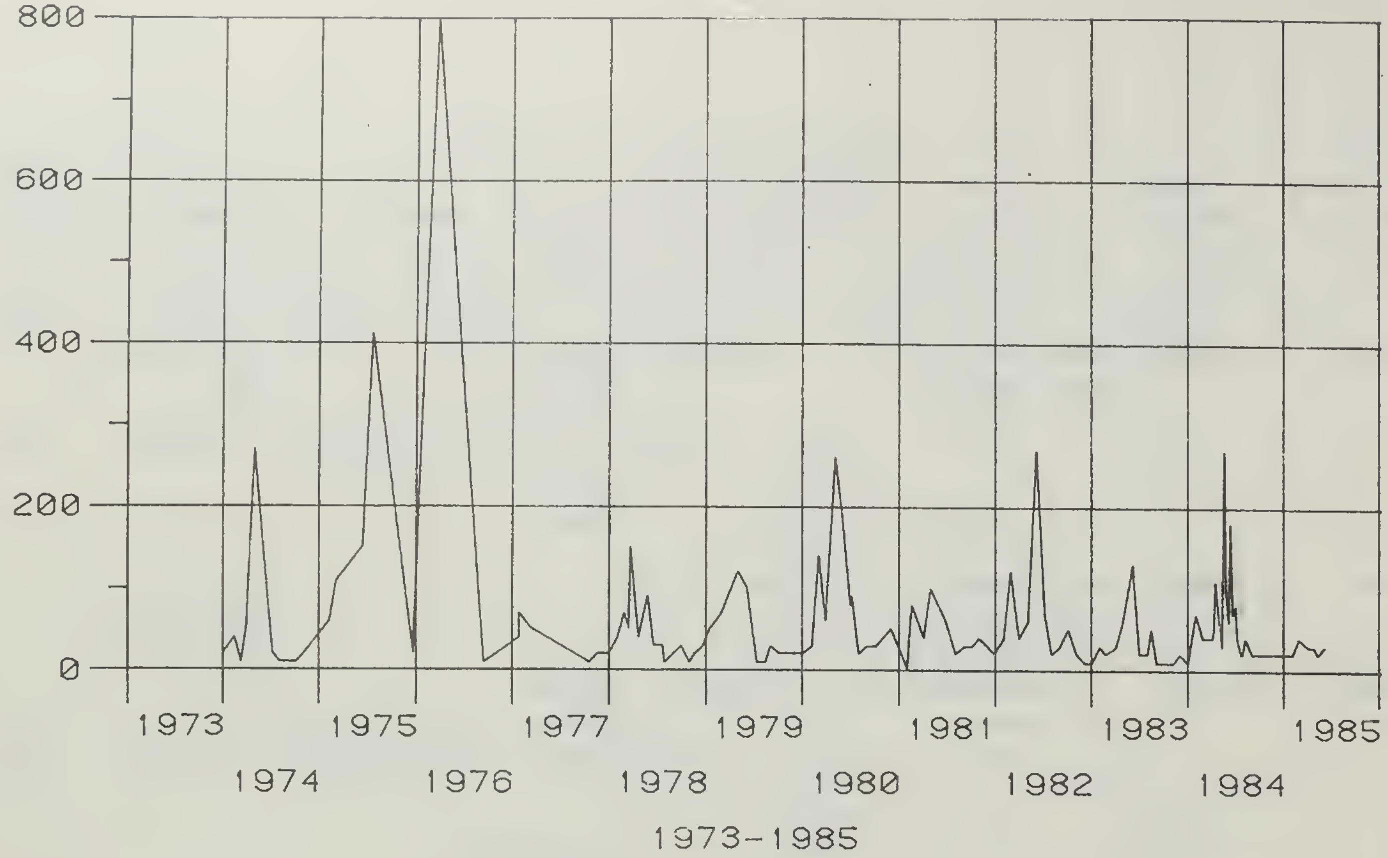

Figure 3-5. Total copper (mg/l) in the Clark Fork River at Deer lodge 1973-1985.

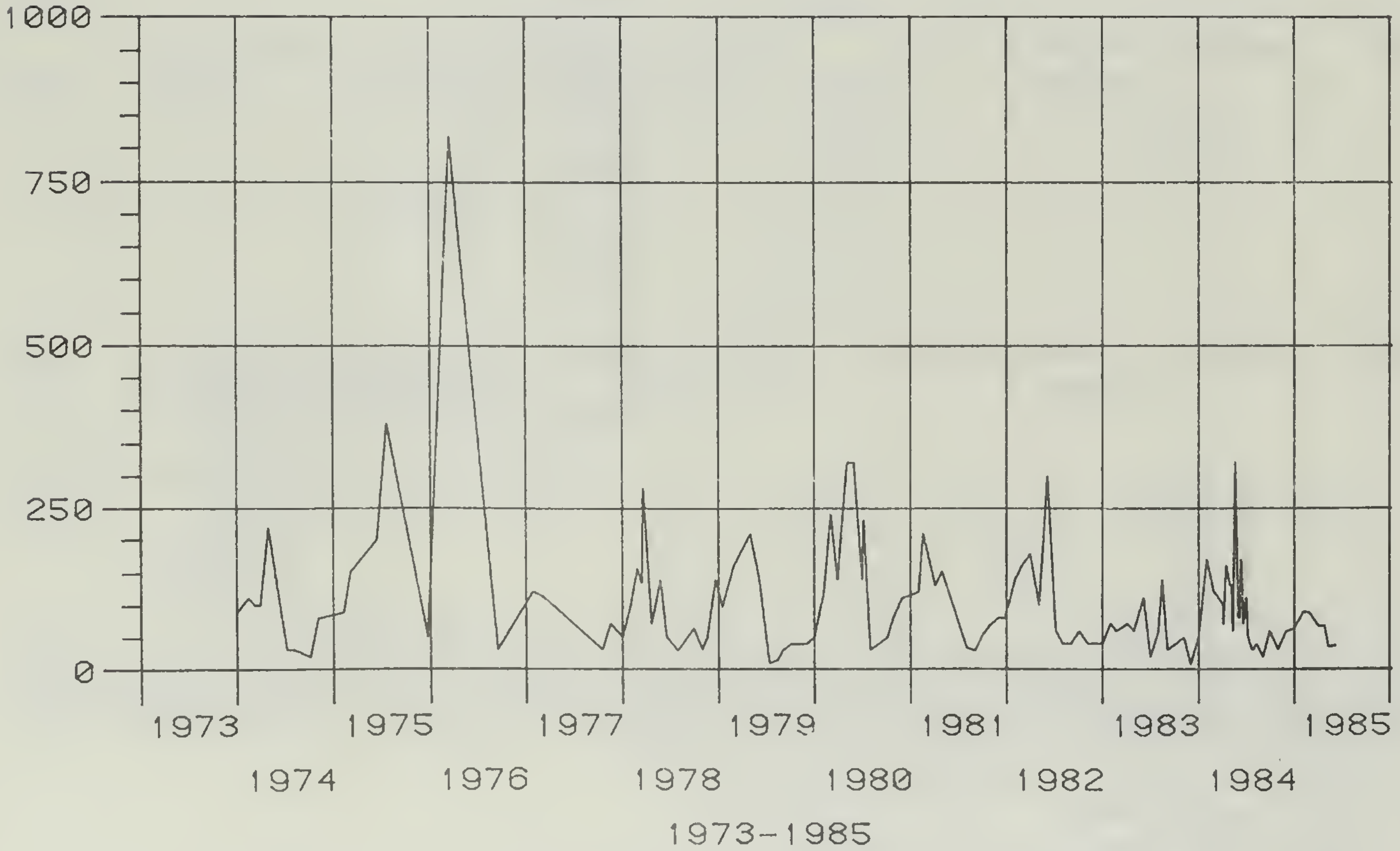

Figure 3-6. Total zinc (ug/l) in the Clark Fork River at Deer Lodge, 1973-1985.

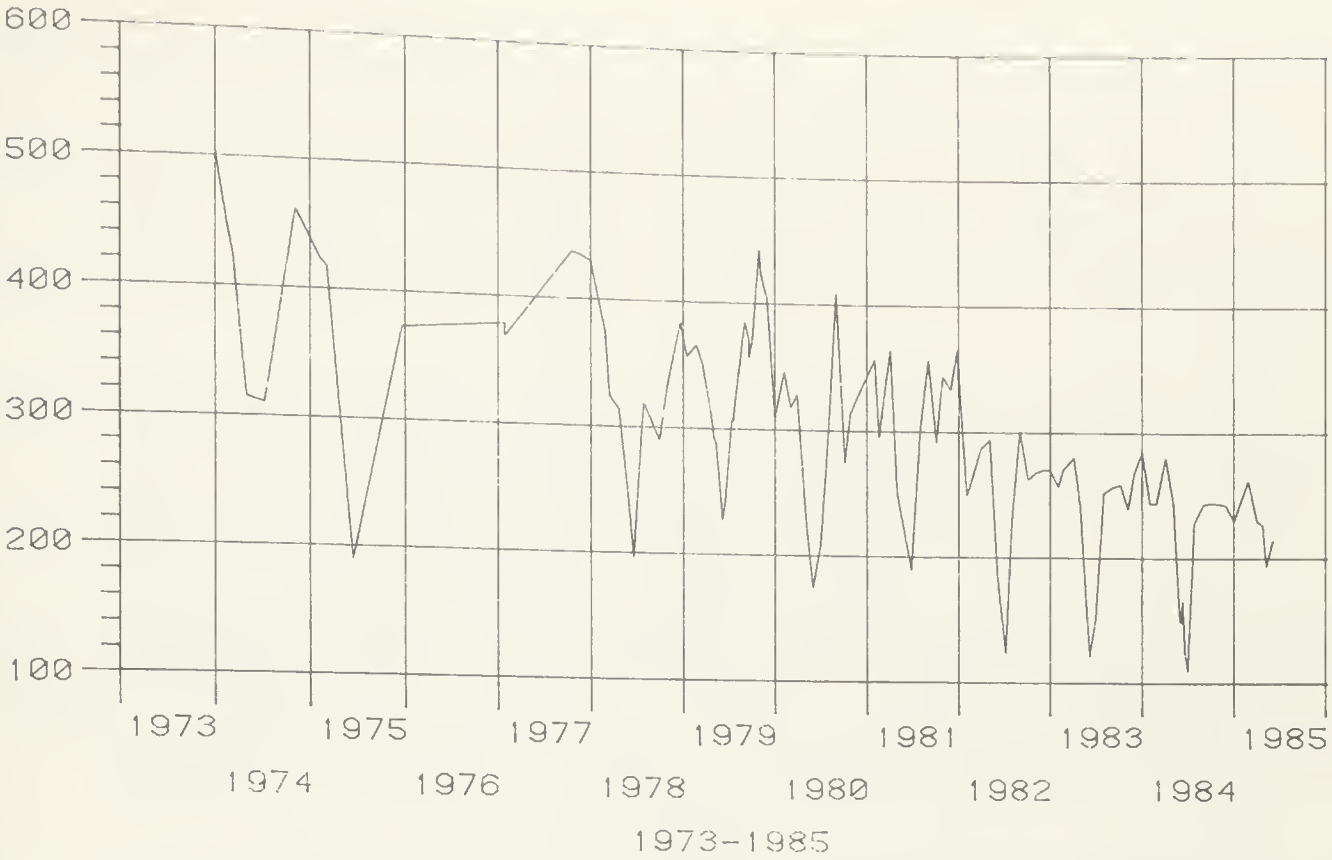

Figure 3-7. Total hardness (mg/l) in the Clark Fork River at Deer Lodge, 1973-1985.

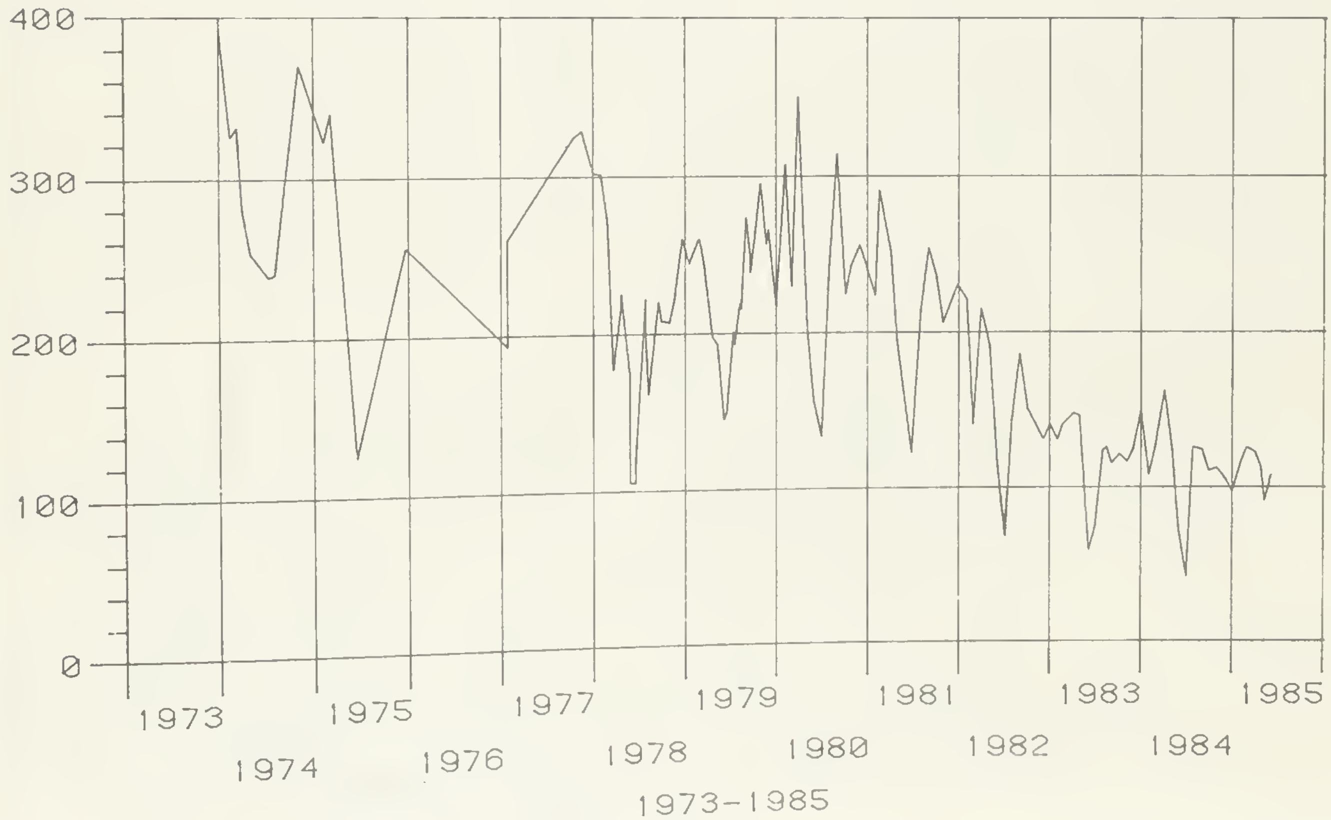

Figure 3-8. Total sulfate (mg/l) in the Clark Fork River at Deer Lodge, 1973-1985.

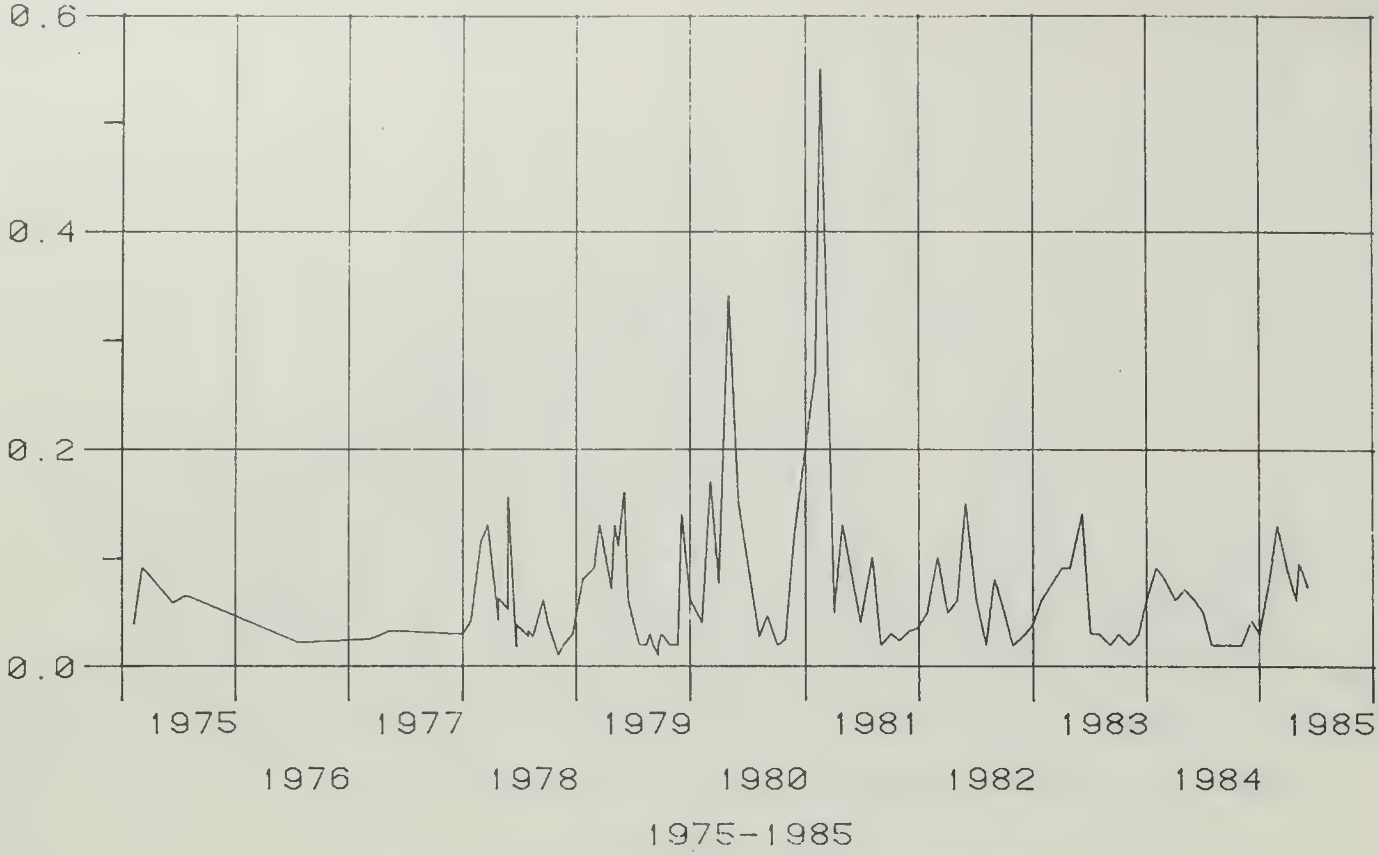

Figure 3-9. Total phosphorus (mg/l) in the Clark Fork River at Deer Lodge, 1973-1985.

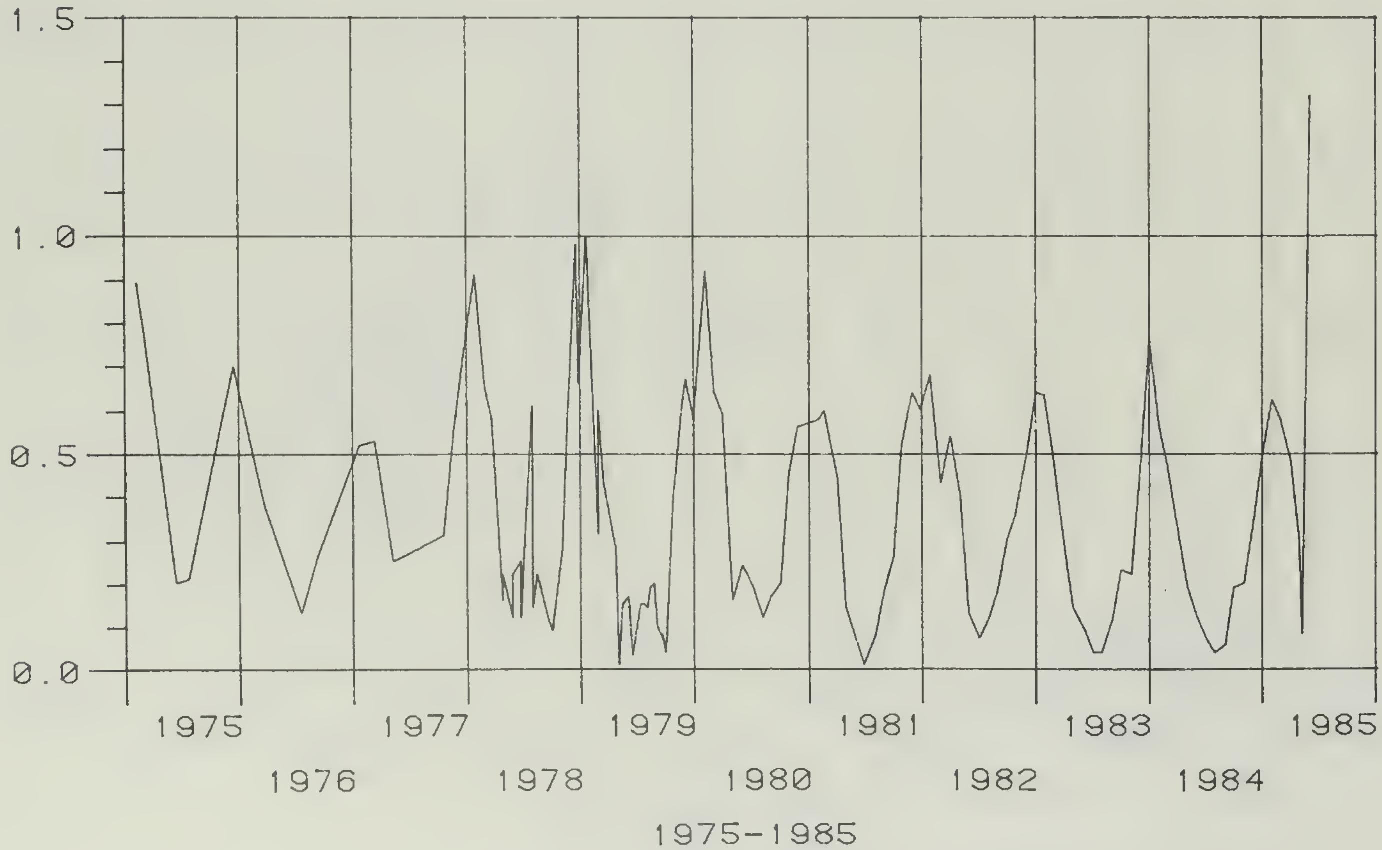

Figure 3-10. Nitrite plus nitrate as N (mg/l) in the Clark Fork River at Deer Lodge, 1973-1985.

3-4), show no statistically valid trends after January 1, 1980. Peaks of phosphorus, like metals, appear to be associated with snowmelt runoff and peaks in streamflow. Concentrations of nitrate appear to follow cycles of algal activity in the river: high concentrations in winter when algal activity is low and low concentrations in summer when algal growth is rapid. Nitrate concentrations also may be affected by streamflow, just as concentrations of phosphorus are influenced by algal uptake.

Long-term biological data also are available for stations on the upper Clark Fork River, on Silver Bow Creek, and on Mill Creek, a relatively unpolluted tributary. Macroinvertebrate samples have been collected annually at these stations by the Anaconda Mineral Company and its contractors. Findings from 1972 through 1984 were presented at the 1985 Clark Fork River Symposium held in Butte.*

No organisms were found in Silver Bow Creek until 1975, when the company improved treatment of mine wastewater at the creek's headwaters. At stations on the upper Clark Fork River, including Deer Lodge, the numbers of invertebrate organisms and taxa have generally been larger since 1980, paralleling the observed improvement in chemical water quality. On the lower Clark Fork River below Missoula, the Institute of paper Chemistry has been monitoring populations of macroinvertebrates in the vicinity of the Stone Container Corporation paper mill since 1956. The results indicate an improvement in water quality since the early years of the mill and, in recent years, a slight enrichment in biological growth below the mill outfall.

3.3. NONSUPPORT OF DESIGNATED USES

Ambient water quality information, when compared to specific state water quality standards and federal water quality criteria, may be used to gauge whether the state's lakes and streams are supporting the uses designated in the water-use classifications contained in the Montana Surface Water Quality Standards. (See Section 3.1.) Another measure of use support is Montana's progress toward the interim goal of the Clean Water Act: that, wherever attainable, fishable and swimmable water quality be achieved.

Meeting the fishable/swimmable goal is defined for the purpose of this water quality assessment as: providing a level of water quality consistent with the goal of protection and propagation of a balanced population of fish and aquatic life, and allowing for recreational activities in and on the water. Fishing advisories, consumption bans, and high incidences of fish abnormalities are indications that waters may not be supporting balanced fish populations. Physical constraints, such as extreme low flows from irrigation withdrawals, also affect fishing and swimming opportunities.

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* Canton, S.P. and J.W. Chadwick. 1986. The aquatic invertebrates of the upper Clark Fork River, 1972-1984. Proceedings--Clark Fork River Symposium, April 19, 1985, Montana College of Mineral Science and Technology, Butte.

The following summaries of use support in Montana streams were prepared according to the instructions contained in EPA's June 1985 Guidance for completing the 1986 State Water Quality Assessments. See Section 3.1.1. for corresponding information about Montana lakes and reservoirs.

Support of Designated Uses

Miles assessed: 19,505
Miles monitored: 3,016
Miles unknown: 1,027
Miles supporting designated uses: 12,184
Miles partially supporting designated uses: 6,934
Miles not supporting designated uses: 387

Miles assessed (19,505) is equivalent to the number of stream miles in the Montana Department of Fish, Wildlife and Parks stream data base as of April 9, 1986. Miles monitored (3,016) is the number of stream miles assessed by regular and repeated sampling by DHES and the U S Geological Survey (USGS) for chemical and biological information. Miles not supporting designated uses (387) is the number of stream miles severely impaired by nonpoint sources of pollution (427; Tables 6-7 and 6-11) plus miles of other streams shown to be severely impaired by point or nonpoint sources (24; Table 3-2) minus the miles of streams (64) classified "E" in the Montana Surface Water Quality Standards. (Impacts on 192 of these 387 miles have been documented by post-1975 data in STORET.) Miles partially supporting designated uses (6,934) is the number of stream miles moderately impaired by nonpoint sources of pollution (6,377; Tables 6-7 and 6-11) plus miles of other streams shown to be moderately impaired by point or nonpoint sources (557; Table 3-2). (Impacts on 4,406 of these 6,934 miles have been documented by post-1975 data in STORET.) Miles supporting designated uses (12,184) is the number of miles assessed (19,505) minus the number of miles not supporting (387) and partially supporting (6,934) designated uses. Miles unknown (1,027) is the estimated number of stream miles not assessed in Montana.

Support of Fishing/Swimming

Miles meeting fishable/swimmable goal: 19,054
Miles unknown: 1,027
Miles not meeting fishable/swimmable goal: 451
- Miles not meeting fishable/swimmable goal but where attainment is anticipated in 5-10 years: 230
- Miles not meeting fishable/swimmable goal and where goal likely will not be attained in 5-10 years: 221

Miles designated fishable/swimmable in Montana Water Quality Standards: 20,468
Miles designated more stringent than fishable/swimmable in Montana Water Quality Standards: 20,422
Miles designated less stringent than fishable/swimmable in Montana Water Quality Standards: 64

Miles not meeting fishable/swimmable goal (451) is the number of miles not supporting designated uses (387) plus the number of miles (64) in streams classified "E" in the Montana Surface Water Quality Standards. Miles not meeting fishable/swimmable goal and where attainment is not likely in 5-10 years (221) is the number of miles in streams severely impacted by inactive mining plus those in Godfrey Creek near Bozeman, Muddy Creek near Great Falls and the Sun River below Muddy Creek. Miles designated fishable/swimmable in Montana (20,468) is the estimated total number of stream miles in the state (20,532) minus the number of miles (64) in streams classified "E" in the Montana Surface Water Quality Standards, which are designated for uses less stringent than fishable/swimmable. The DHES considers "drinking, culinary and food processing" uses to be more stringent (require cleaner water) than fishable/swimmable uses. All waters in Montana, except those classified "C-1", "C-2" and "E" in the Montana Surface Water Quality Standards, are designated as suitable for drinking, culinary and food processing purposes. Miles designated more stringent than fishable/swimmable (20,422) is the estimated total number of stream miles in the state (20,532) minus the number of miles (110) in streams classified "C-1", "C-2" and "E".

3.3.1. MAJOR SOURCES

The following assessment of sources of nonsupport of uses was prepared according to the instructions contained in EPA's June 1985 Guidance for completing the 1986 State Water Quality Assessments. As it is used here, nonsupport applies to waters (both lakes and streams) identified in the previous sections as not supporting or only partially supporting designated uses

Percent nonsupport caused by industrial sources: 2%

Percent nonsupport caused by municipal sources: 3%

Percent nonsupport caused by nonpoint sources 95%
- Agriculture: 46%
- Forest Practices: 3%
- Mining: 7%
- Land Disposal: 12%
- Hydromodification: 26%
- Urban Runoff: less than 1%
- Construction: less than 1%
- Other: less than 1%

It should be noted that almost all of the Montana waters (218 out of 237 stream miles) in which designated uses are not fully supported because of industrial sources are the result of oil production water discharges to the Powder River system in Wyoming (see Section 5.12.) Also, almost all of the nonsupport due to mining is due to inactive or abandoned operations. Although the percentage of waters affected by mining is small, this source often has a much more severe impact than other sources.

3.3.2. MAJOR CONTAMINANTS

Five pollutants or pollutant groups are responsible for most poor water quality in Montana. These are, in order of decreasing importance:

1. Sediment/turbidity;
2. Salinity/dissolved solids;
3. Heavy metals;
4. Nutrients; and
5. <u>Giardia</u> <u>lamblia</u>.

Except for nutrients from municipal wastewater treatment plants, the preponderance of these contaminants originate from non-point sources as shown in the previous section. Agricultural practices are the principal sources of excessive sediment in lakes and streams On-site land disposal of domestic wastewater and discharges from municipal wastewater treatment plants contribute most of the problem nutrients to Montana waters. Agricultural practices are also responsible for salinization of surface and ground waters via irrigation return flows and saline seep. Heavy metal impacts tend to be localized but severe, except in Silver Bow Creek and the upper Clark Fork River, where they are extensive and severe. Most heavy metals pollution originates from inactive or abandoned mines. <u>Giardia</u> <u>lamblia</u> is an intestinal parasite that is a natural pollutant throughout the mountainous western one-third of Montana. (See section 5.3.) Although <u>Giardia</u> does pose a threat to outdoor enthusiasts and municipalities that do not adequately treat their drinking water, it is not and need not be the cause of nonsupport of recreational and public water supply uses of lakes and streams. Techniques for treating water to kill or remove <u>Giardia</u> are available.

While it is not a pollutant in the strict sense of the word, alteration of physical habitat does seriously impair the ability of many Montana lakes and streams to support healthy populations of fish and aquatic life and the ability of many wetlands to support waterfowl. Most frequently, habitat is affected by dewatering for irrigation, unauthorized stream channel alterations, dredging and filling for construction and by extreme fluctuations of hydroelectric reservoirs for power production. Dewatering may also impair a stream's ability to assimilate wastes.

3.4. PUBLIC HEALTH/AQUATIC LIFE CONCERNS

Achieving "fishable/swimmable" status for waters in Montana requires an analysis of pollutants that threaten aquatic life and public health. The following sections summarize what is known about how toxic and nontoxic contaminants threaten public health and limit recreation on Montana's waters.

3.4.1. TOXIC CONTAMINANTS

Toxic pollutants are a growing concern throughout the country. Fortunately, Montana has little of the dense population, intensive

agriculture and heavy industry that has resulted in serious toxics problems in other states. Concern in Montana is focused on two groups of toxics: heavy metals and chlorinated hydrocarbons, including PCBs and PCPs (polychlorinated biphenyls and pentachlorophenol). Of these, only heavy metals have been shown to be a problem in Montana surface waters. (See also Section 4.2. Ground Water Quality Problems.)

Approximately 700 miles of Montana rivers and creeks in 48 stream segments regularly experience concentrations of heavy metals that exceed EPA criteria for the protection of aquatic life. Biological surveys have documented a reduction in the number and diversity of aquatic plants or animals in 10 segments covering 300 miles. Thirty-five acres in one lake (Park Lake in Jefferson County) are threatened by heavy metals. Abandoned or inactive hardrock metals mines are the sources for almost all of this pollution.

Only one fish consumption advisory has been issued in Montana (1984), and that was because of elevated levels of mercury in trout in the upper reaches of Silver Creek near Helena below mining operations in the Marysville District. In older and larger fish, mercury does sometimes exceed the Food and Drug Administration (FDA) action level (1 mg Hg/g) in the edible flesh of fish taken from Nelson, Tongue River, Yellowtail and Fort Peck reservoirs in eastern Montana and from Fred Burr Creek near Philipsburg in western Montana. Fred Burr Creek is in an historic mining district; the source(s) of mercury at the other locations is unknown. (See Section 3.1.3. for information on selenium in wetlands.)

Samples for analysis of chlorinated hydrocarbons in fish have been collected in recent years from a large number of waters in Montana, including Flathead Lake, Silver Bow Creek, Big Spring Creek, and the Clark Fork, Missouri, Madison, Marias, Bighorn and Boulder rivers. Most of the chlorinated hydrocarbons were present at concentrations below analytical detection limits. When residues were detected, the concentrations were very low and below existing guidelines for human consumption. Sources of chlorinated hydrocarbons in Montana include pesticides, wood treatment plants and electrical equipment.

There have been no known incidences of fish found with tumors, lesions, disease or other abnormalities resulting from toxics in water, nor have swimming areas had to be closed because of toxics other than toxic algae. Toxic, metals-bearing sediments are a concern at most abandoned mine sites and particularly in the Clark Fork River where they have accumulated behind hydroelectric dams, e.g. Milltown dam near Missoula. Arsenic from these sediments contaminated the Milltown community water supply until the source was changed and the system was replaced by a Superfund cleanup action. An increase in gold mining and extraction operations has increased the threat of water contamination by cyanide solutions used in the extraction ("heap leaching") process.

3.4.2. NONTOXIC CONTAMINANTS

Among the conventional pollutants, sediments from agriculture, forest practices, mining and highway construction pose the largest

problem for aquatic life in Montana waters. Accelerated road building and timber harvest on U.S. Forest Service lands now pose the greatest single threat to aquatic life. Sediments and organic wastes derived from agricultural practices have precluded fishing and recreation in a few severely impacted streams, for example Muddy Creek near Great Falls and Godfrey Creek near Bozeman

Algal nutrients, particularly phosphorus, are a concern in Flathead and Whitefish lakes and in the Clark Fork River drainage feeding Lake Pend Oreille in Idaho. Unnaturally high summertime temperatures are a concern wherever streams are excessively dewatered by irrigation withdrawals. Critically low dissolved oxygen concentrations are a concern in Ashley Creek below the Kalispell wastewater treatment plant, but in few other streams in Montana

Other than an outbreak of giardiasis in Missoula in 1984, there have been no incidents of waterborne disease in Montana in the last two years. (See Section 5.3. for more information on *Giardia*.) Because of blooms of toxic algae (*Anabaena flos-aquae*) that killed a number of head of livestock, the shorelines of Canyon Ferry and Hebgen reservoirs were posted with warning signs in the summers of 1984 and 1985, respectively. (See Section 5.5.) Schistosome cercarial dermatitis ("swimmers' itch") is a recurring problem in Flathead Lake, where it has intensified over the last 10 years.

3.5. PRIORITY WATER BODIES

The term "priority water bodies" is a management concept originated by EPA to encourage states to focus resources and control activities in areas where water quality decisions are needed. Although the Clean Water Act does not require states to develop a general priority water body list, states are encouraged to do so. State priority water body lists should provide an overall agenda of needed control actions and may include waters not meeting standards, as well as waters where controls are needed to maintain uses (40 CFR Parts 35 and 130, Federal Register, Vol. 50, No.8).

Generally, from the standpoint of restoration of uses, the stream segments in Table 3-2 and the lakes in Table 6-12 are priority water bodies. Pollution sources and control programs for these problem streams and lakes are discussed in sections 3.1.1., 3.1.3. and 6.2.2. Of the problem stream segments in Table 3-2, use attainability studies or assessments are needed for Hot Springs Creek, Muddy Creek, Prickly Pear Creek, and Silver Bow Creek.

For protection of existing uses, Flathead Lake and Whitefish Lake are priority waters. (See sections 3.1.2., 5.1., 6.5.1 and 6.5.2. for an explanation of sources and control programs.) The highest priorities in Montana for advanced wastewater treatment construction and for application of best management practices to nonpoint sources are in the Flathead Lake drainage. An effluent limit of 1 mg phosphorus per liter has been established for all MPDES discharges in the Flathead Basin (see Section 6.5.2.).

Waters in the Clark Fork River drainage are priority waters, some for restoration of uses (i.e., those Clark Fork Basin waters in Table 3-2) and the others for protection of existing uses. Causes of water quality problems in the Clark Fork Basin are explained in Section 5 2 ; control programs are discussed in Section 6.5.3. and elsewhere in this report. In addition, funds are being sought by the staff of the Clark Fork River Basin Project in the Governor's Office to prepare an overall water quality management plan for the river. The Clark Fork River drainage could be a candidate for nutrient allocations among municipal and industrial dischargers pending results of a proposed State of Idaho eutrophication study on Lake Pend Oreille.

Highest priority waters for DHES ambient monitoring are Silver Bow Creek, the Clark Fork River and Flathead Lake. (See sections 6.4.1. and 6.4.2.) Other priority waters for monitoring are those addressed in sections 6.4.3. through 6.4.8.

4. GROUND WATER QUALITY

The first section of this chapter describes where ground water is available and how it is used in Montana. This includes the type and distribution of water-bearing formations and the demands on ground water resources. Several categories of pollutants and documented ground water contamination sites are identified in the next section. Existing ground water quality research projects and potential management alternatives are discussed in the final sections.

4.1. GROUND WATER OCCURRENCE AND USE

4.1.1. GENERAL SETTING

Ground water in Montana occurs in two distinct hydrogeologic regimes. The first is in western and south-central Montana (the Northern and Middle Rocky Mountains physiographic provinces). This area generally consists of a series of structurally complex mountain ranges separated by downfaulted intermontane valleys containing as much as 16,000 feet (ft.) of Cenozoic basin-fill sediments. Annual precipitation ranges from 8 inches (in.) in the valleys to about 120 in. in the mountains. The second is in eastern and north-central Montana (the Great Plains physiographic province). Moderately dissected plains underlain by Cenozoic and Mesozoic sedimentary rock are locally interrupted by small mountain ranges. Annual precipitation ranges from 12 to 30 in.

4.1.2. PRINCIPAL AQUIFERS

Most ground water used in western and south-central Montana is from aquifers that consist of alluvial, glacial and basin-fill deposits of unconsolidated to semiconsolidated gravel, sand, silt and clay. Adequate water supplies for domestic and stock purposes can usually be obtained from depths of less than 200 ft. Yields are often sufficient to supply irrigation, public supply or industrial uses. Ground water obtained from western alluvial and basin-fill deposits generally has a dissolved solids concentration of less than 300 milligrams per liter (mg/l). Western glacial deposits yield water with a dissolved solids concentration typically less than 200 mg/l.

In eastern and north-central Montana, ground water is available from alluvial and glacial deposits and consolidated sedimentary formations. Alluvial deposits are present along major river valleys, and these deposits yield water to private and public supply wells in valleys. Pleistocene glacial debris, deposited by continental ice sheets, forms a veneer over much of north central and northeastern Montana. The glacial deposits hold adequate water supplies for stock and domestic needs. Ancient stream gravels buried by glacial drift are sometimes very productive, yielding sufficient water for irrigation. The distribution of Cenozoic alluvial fill aquifers in Montana is shown in Figure 4-1. Eastern alluvial and glacial deposits produce water with a dissolved solids concentration of up to 2,200 mg/l.

The Tertiary Fort Union Formation is a moderately consolidated

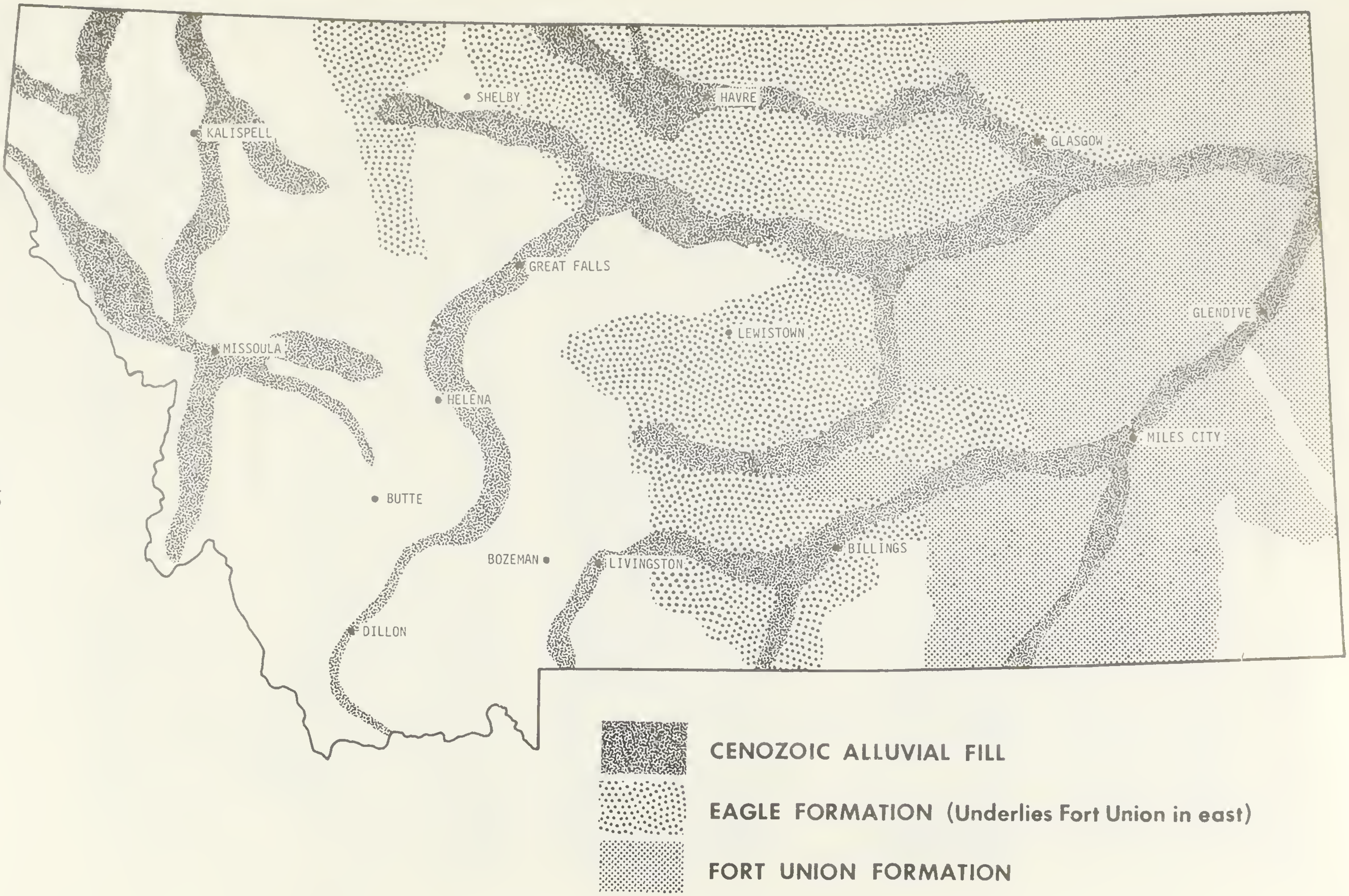

Figure 4-1 Principal aquifers in Montana.

sedimentary formation which is used as an aquifer in eastern Montana. The location of the Fort Union Formation is shown in Figure 4-1. The aquifer consists primarily of continental shale, siltstone, fine sand, sandstone and coal. Wells yield sufficient water for rural domestic and livestock needs. Ground water from the Fort Union generally has a dissolved solids content of less than 1,800 mg/l.

Beneath the Fort Union Formation is a series of Cretaceous formations that consist mainly of alternating sandstone, shale and siltstone layers. Sandstone units in this group transmit usable qualities of ground water. The Eagle Formation is one of the more widely used aquifers in this group of water-bearing formations. The extent of the Eagle Formation in Montana is shown on Figure 4-1 The aquifer commonly yields adequate ground water for most stock and domestic needs. The majority of the wells are installed near the outcrop area of the aquifer or where a satisfactory shallow supply from another formation is not available. The Eagle aquifer produces ground water with a dissolved solids concentration usually less than 2,300 mg/l.

4.1.3. GROUND WATER USE

Approximately 2 percent of the total amount of water used in the state of Montana is ground water. However, ground water sources provide potable water for 55 percent of Montana's population. Accurate information on ground water usage is difficult to obtain The Montana Department of Natural Resources and Conservation (DNRC) has developed estimates for ground water use in the state (Table 4-1). Estimates are based on irrigated acreage, consumption by crops, public water supply records, water rights, surveys and other considerations. Irrigation consumes the largest part of ground water used in Montana. Irrigation is followed, in order of decreasing consumption, by public water supply systems, industrial, rural domestic and livestock uses.

Table 4-1. Estimate of annual ground water use in Montana

Use	Acre-feet of ground water
Irrigation	155,000
Public water supplies	61,000
Industry	33,000
Rural domestic	16,000
Livestock	9,000
Total	274,000

Source: Department of Natural Resources and Conservation

4.2. GROUND WATER QUALITY PROBLEMS

A variety of ground water quality problems occur throughout Montana. Impacts on ground water quality range from agricultural practices to waste disposal methods (Table 4-2). Severity depends on the character of the aquifer, use of the ground water and nature of the contaminants. Some of the major contaminants which have altered the state's ground water include: fertilizers, pesticides, hydrocarbons, heavy metals and salts (Table 4-3). Areas in Montana with known or suspected contamination are shown in Figure 4-2.

Ground water quality problems are as varied as the many types of polluting materials. Most operations that can cause pollution, such as mining, are regulated by a state agency. Unregulated operations, not subject to some type of permitting requirements, must still comply with ground water quality standards contained in the Montana Ground Water Pollution Control System. (See Section 6.3.) The following section identifies locations in the state where ground water contamination has been documented.

4.2.1. CYANIDE IN GROUND WATER

Historic and present mining and mineral extraction practices have degraded ground water quality at some Montana locations. Recently, gold processing sites that use cyanide-bearing solutions to extract gold from ore have caused ground water contamination.

Golden Maple Mining and Grayhall Resources - Lewistown. A heavy rainstorm caused containment structures holding cyanide solutions to overflow at both sites near Lewistown. Ground water downgradient from each site was contaminated with cyanide. Additional monitoring will determine the extent of impacts and possible corrective actions.

Golden Sunlight Mines, Inc. - Whitehall. The improper construction of a slurry wall below an earthen impoundment resulted in the escape of cyanide-bearing solutions. This also resulted in downgradient ground water contamination. Golden Sunlight is evaluating the extent of degradation, and is working on improving its techniques for cyanide analysis.

Falcon Exploration - Elkhorn. Failure of synthetic pond liners allowed cyanide solutions to enter the ground water The DHES is attempting to force the company to initiate corrective action.

4.2.2. PETROLEUM IN GROUND WATER

Ground water contamination by petroleum products has become a problem in Montana. More than 50 petroleum contamination complaints have been reported to the DHES in the last two years. The creation of state regulations for underground hazardous material storage tanks will increase awareness of the problem, and likely lead to the discovery of more leaking tanks and pipes. Currently in Montana there are 15 locations where reported fuel leaks are being investigated by responsible parties.

Table 4-2. Major sources of ground water contamination in Montana

Source	Major Source	Rank*
Septic tanks	X	4
Municipal landfills		
On-site industrial landfills (excluding pits, lagoons, surface impoundments)		
Other landfills		
Surface impoundments (excluding oil and gas brine pits)	X	6
Oil and gas brine pits		
Underground storage tanks	X	1
Injection wells		
Abandoned hazardous waste sites	X	3
Regulated hazardous waste sites		
Salt water intrusion		
Land application/treatment		
Agricultural activities	X	5
Road salting		
Mineral Processing	X	2

* I = most serious

Table 4-3. Substances contaminating ground water in Montana.

Organic chemicals:	
Volatile	X
Synthetic	
Inorganic chemicals:	
Nitrates	X
Fluorides	
Arsenic	X
Brine/salinity	X
Cyanide	X
Metals	X
Radioactive material	
Pesticides	X
Other (specify)	

Figure 4-2

MONTANA
1985
Groundwater Contamination

Town of Dillon. Approximately 20 residents and businesses in the northern part of Dillon complained of petroleum in shallow wells and petroleum vapors in basements. A study funded by an insurance company determined that a portion of the contamination could be attributed to a leaking buried tank. Other potential sources of petroleum contamination in the area and the extent of ground water contamination have not been identified.

Town of Lincoln. There is a risk that 13 shallow wells could become polluted with petroleum in Lincoln. Gasoline leaks and spills, from three gasoline stations situated at the same intersection, are the origin of contamination. Monitoring will continue and possible remedial actions are being evaluated.

Town of Judith Gap. Public supply wells in Judith Gap are polluted with gasoline. Two attempts to install a new supply well outside of the contaminated area have failed. The extent of contamination will be investigated to determine if possibilities exist for product recovery or revitalization of existing wells.

Champion Building Products - Missoula. Gasoline leaking from an underground fuel tank has contaminated domestic wells in an eight square-block area. Champion has provided 16 property owners with new wells. Monitoring will continue to determine if other supplies are threatened.

Hayes Auto Service - Great Falls. Fuel leaks from underground tanks have contaminated perched ground water and caused potentially explosive vapor problems in the nearby sanitary sewer. Leaking tanks have been replaced, and a vent fan installed on the sewer to evacuate petroleum vapors. An interception trench will be installed to collect and remove gasoline and contaminated ground water.

4.2.3. PESTICIDES IN GROUND WATER

Widespread contamination of ground water caused by application of fertilizers and pesticides has not been documented in Montana. However, degradation has occurred at sites where pesticide applicators have mismanaged waste pesticide solutions.

Missoula County Weed District. Liquid flushed through spray heads and from washing spraying equipment was discharged to an open-bottom sump overlying a valley-fill aquifer. Pesticide residues entered the ground water and contaminated several domestic and public supply wells with low levels of Tordon. These disposal practices have been discontinued. Monitoring will continue and precautions taken to ensure that levels of contamination do not increase.

Malta Airport - Malta. Spillage from aerial pesticide applicators has contaminated shallow ground water and soils with 2,4-D. Further investigation is needed to determine the severity of impacts.

Degradation of groundwater by pesticides and other chemicals has been studied by the Department of Agriculture on a limited basis across Montana. Various pesticides are frequently used to protect crops from insects, diseases and weeds Three distinct agricultural production areas were selected for groundwater sampling: Flathead and Lake counties, Beaverhead and Madison counties, and Teton County. Samples were analyzed for organochlorines (chlorinated hydrocarbon), aldicarb, phenoxy herbicides (like 2,4-D) and picloram (Tordon).

No pesticides were found in the groundwater in Flathead, Lake, Beaverhead or Madison counties. However, low levels of 2,4-D, Tordon and other pesticides were detected in several wells in Teton County. Contamination may have resulted from pesticide application, although improper handling, storage or disposal cannot be ruled out.

Most of the farmland in the areas sampled is flood irrigated. Typically, the water table rises after the onset of the irrigation season, distributing fertilizers, pesticides and other chemicals throughout the soil profile. Excessive irrigation may contribute to leaching of the pesticides into the groundwater. Some pesticides are mobile and persist longer in the subsoil than near the soil surface.

The levels of pesticides detected are below health guidance levels and do not appear to present an immediate health danger. Nevertheless, pesticide contamination of groundwater is undesirable. Monitoring is proposed to continue in Teton County and precautions will be taken to ensure that the level of contamination does not increase. Investigations are proposed in other agricultural areas of the state.

4.2.4. REGULATED WASTE SITES

The Montana Hazardous Waste Act (MHWA) and certain projects under the federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) are implemented by the DHES Solid and Hazardous Waste Bureau. Management of regulated wastes at active facilities is subject to MHWA requirements. CERCLA requirements apply to locations where regulated wastes are located at inactive or abandoned sites. The following is a status summary of MHWA and CERCLA sites in Montana where existing or potential ground water contamination problems occur

4.2.4.1. MHWA SITES

Facilities that treat, store or dispose of hazardous wastes on site in Montana have been operating under temporary or interim (Part A) permits. These facilities are now in the process of applying for permanent (Part B) operating permits. Hazardous waste storage impoundments, waste piles, landfills and land treatment areas are required to implement stringent ground water monitoring programs as part of their Part B permits. The status of each MHWA facility in Montana is described below.

<u>Burlington Northern Paradise Tie Treating Plant</u>. Burlington Northern (BN) is in various stages of obtaining permits for the following activities: storage of creosote wastes in a waste pile, closure of a

surface impoundment that contains creosote wastes, conducting a demonstration for land treatment of creosote wastes and a test burn for incineration of creosote wastes. BN is also designing a corrective action program to address creosote constituents in ground water associated with the closed surface impoundment.

Burlington Northern Somers Tie Treating Plant. Operation of a surface impoundment to store creosote wastes will require a permit. Low levels of ground water contamination near the impoundment will be evaluated to determine appropriate action.

CENEX Refinery - Laurel. CENEX has applied for a permit for land treatment of petroleum refining wastes. A ground water quality assessment program is underway to determine if the land treatment area has contaminated ground water.

Exxon Billings Refinery and Conoco Land Treatment Facility - Billings. Each site is pursuing a Part B permit for land treatment of petroleum refining wastes. Extensive subsurface and ground water quality investigations are being done to evaluate the ground water flow system and aid in the design of an appropriate ground water monitoring network for each facility.

Conoco Billings Refinery. Ground water monitoring conducted under a post-closure permit is necessary to assess the impacts on local ground water caused by refinery wastes stored in old, unlined surface impoundments.

Montana Refining Company - Great Falls. Montana Refining Company has notified the DHES that it intends to close a hazardous waste land treatment area. Additional compliance monitoring will be required for a post-closure permit.

Transbas Inc. - Billings. Surface impoundments used to store pesticide formulation wastes will be closed and a post-closure permit issued. Levels of 2,4-D contamination in ground water caused by past releases have been reduced to non-detectable levels by a treatment system which employs hydrodynamic controls and charcoal filters. Ground water monitoring will continue for the post-closure period.

4.2.4.2. CERCLA SITES

Anaconda Smelter - Anaconda. Remedial Investigation and Feasibility Studies (RI/FS) are continuing. Various levels of heavy metals have been detected near tailings impoundments and waste dumps on the smelter site. Geochemical models are being developed to examine the fate of heavy metals emanating from the site and associated risks

East Helena Smelter - East Helena. A draft water resources investigation has been completed by ASARCO. This investigation documented arsenic and sulfate contamination in shallow ground water at the site. Methods to correct contamination will be examined in a future study.

Libby Ground Water Contamination - Libby. The site RI/FS being conducted by Champion International continue. These investigations have revealed significantly more aquifer contamination than originally estimated. Gross levels of creosote and pentachlorophenol have been discovered in deep portions of the alluvial aquifer. Potential corrective actions are being evaluated concurrently with the site investigation.

Milltown Reservoir - Milltown. Residents with wells contaminated by heavy metals have been provided a new, contaminant-free public supply system. The RI/FS are almost complete. Techniques to remove, treat or contain heavy-metal laden sediments impounded behind the dam are being studied.

Silver Bow Creek - Butte. The Silver Bow Creek site has been expanded with the addition of potential source areas in the Silver Bow Creek headwaters. The RI/FS for the original portions of the site are to be completed by late 1986. Preliminary results suggest tailings deposited in the Silver Bow Creek valley by man's activities and fluvial action continue to contribute to heavy-metal and arsenic contamination of alluvial aquifers and the Silver Bow Creek-Clark Fork River system.

Idaho Pole Company - Bozeman. Pentachlorophenol from wood treating operations has entered the ground water in the vicinity of Idaho Pole. The extent of the problem is being studied by the company to comply with a DHES administrative order. Negotiations with the company on planning RI/FS will begin as soon as funding is available.

Mouat Industries - Columbus. Hexavalent chromium is present in soils, surface and ground water both on and off the site at Mouat Industries. This occurred due to improper handling of chromium ore processing wastes. As soon as funds are available through CERCLA reauthorization, RI/FS will be scheduled.

Several sites in Montana have been proposed for the National Priority List (NPL). A final determination by EPA on these sites is expected in early 1986. Investigative work (RI/FS) can proceed, but no CERCLA-financed remedial action may occur until the final determination is made. Proposed CERCLA sites are briefly described below.

Burlington Northern Somers Tie Treating Plant - Somers. An administrative order was signed between EPA and BN in October 1985 that requires BN to conduct approved RI/FS at the site. To prevent the release of significant amounts of creosote to Flathead Lake, contaminated materials have been excavated from an old pond, and a dike was constructed along the lakeshore. The extent of ground water contamination by creosote compounds near the pond and at other locations on site is being examined during the RI/FS.

Montana Pole and Treating - Butte. Pentachlorophenol and petroleum from wood treating and preserving operations have contaminated ground water and entered Silver Bow Creek. The company discontinued the wood treating business in the early 1980s. The DHES ordered Montana Pole and Treating to take corrective action in May 1984, and the EPA started

removal actions at the site in July 1985. All waste materials are still on site because there are no permitted disposal facilities in the U.S.

Additional investigations are being funded by CERCLA to examine other locations in Montana that may justify ranking on the NPL Preliminary Assessments (PAs) have been conducted at 70 sites where contamination of soils, surface or ground water was suspected PAs include reviews of existing and historical information pertaining to a site, evaluation of the site's physical characteristics and an examination of potential impacts to the surrounding population and environment.

If the PA suggests potential threats exist, a Site Investigation (SI) is conducted. SIs have been completed, or are in progress, at 24 locations. Sampling of waste materials, soil and surface water is included in the SI. Monitoring wells are often installed at sites where existing wells do not provide adequate ground water samples. Various levels of ground water contamination have been detected at seven sites as a result of SI work.

4.2.4.3. EMERGENCY CLEAN-UP ACTIONS

The EPA Emergency Response Team was called in to Montana on two occasions during 1984-85 to correct emergency situations that threatened ground water quality. Details of each site and a description of the emergency response actions are presented below.

Motherlode - Helena. The Motherlode processing plant, situated in the Helena Valley, used a cyanide leach process to extract silver from spent photographic film. A fire destroyed the plant and resulted in the spillage of cyanide-bearing liquids. Ground water quality in the area was threatened. The owner of Motherlode did not have the financial resources to adequately abate the problem. The EPA Emergency Response Team activities aimed at the immediate removal of cyanide waste liquid and cyanide contaminated soil. Three ground water monitoring wells were installed and sampling was conducted over a 12 month period to monitor the migration of a cyanide plume. Downgradient users of ground water were not affected by the release

Montana Pole and Treating Plant - Butte. Montana Pole and Treating Plant in Butte uses pentachlorophenol (PCP) mixed with oil to treat posts and poles. Historically, wastes from the plant were discharged to an unlined impoundment and allowed to infiltrate into the underlying alluvial aquifer. Seeps of PCP and oil developed along the banks of nearby Silver Bow Creek. The treating plant had closed and the former owner had no means to implement corrective actions The EPA Emergency Response Team, in cooperation with the U.S. Coast Guard, constructed diversions in the creek and trenches in the shallow aquifer to intercept and recover the PCP-oil mixture. A ground water monitoring network was installed and contaminated structures and soil were removed from the site. Interception and removal of the PCP-oil mixture in the ground water will continue during 1986.

4.3. GROUND WATER RESEARCH

Ground-water research is being done in Montana by a variety of state and federal agencies. Most studies are designed to evaluate ground water quality and quantity issues in a particular basin or area of concern. The following discussion identifies major studies that focus primarily on ground water quality problems. The lead agency, or organization responsible for the particular study, is also identified

United States Geological Survey (USGS)

Statewide Monitoring. This involves the collection of ground water quality samples at about 90 sites in eastern Montana on a 4-year rotational basis (20 samples per year). Data are used to support various studies of regional ground water quality.

USGS in cooperation with Montana Bureau of Mines and Geology

Upper Clark Fork Ground Water. This project is designed to asses the occurrence and quality of ground water in shallow aquifers along the Clark Fork River from near the headwaters to Milltown. Ground water-surface water relationships will be studied as part of the project

Corbin-Wickes. This project is aimed at documenting water quality conditions in the Corbin-Wickes area prior to renewed mining. Particular emphasis is on ground water quality.

Bureau of Land Management (BLM)

Hanging Woman Creek. This project is being done to evaluate the cumulative impacts of potential coal mining activities on ground water and surface water quality in the Hanging Woman Creek basin of southeastern Montana.

Bureau of Indian Affairs (BIA)

Flathead Reservation Canal Seepage This project is designed to determine the magnitude and time distribution of canal leakage in representative geologic terrains within the reservation, determine the hydraulic and geochemical effects on the ground water system near the canals and assess the transferability of the findings to the entire reservation.

Montana Bureau of Mines and Geology (MBMG)

Geraldine and Stillwater County Saline Seep Studies. This work examines the cause, transport and control mechanisms of saline seeps, with emphasis on the fate of heavy metals, particularly selenium.

Acid Mine Drainage Control in the Sand Coulee Creek and Belt Creek Watersheds. Recharge to abandoned coal mines results in acid mine drainage problems for these two watersheds. Controls to reduce recharge and subsequent acid production, such as interception wells, agricultural controls and various engineered alternatives, are being evaluated

Ground Water Resources Along the North Shore of Flathead Lake
Phosphorus entering Flathead Lake threatens the water quality of the lake. Natural sources of phosphorous in surface and ground water along the north shore are being studied.

Water Monitoring of Colorado Tailings. Seepage of heavy metals from a large tailings deposit along Silver Bow Creek is being monitored to determine the effectiveness of control measures.

Research Sponsored by the Department of Natural Resources and Conservation, Water Development Program

Statewide Ground Water Information Center. This effort entails development and operation of a statewide Ground Water Information Center by the MBMG to organize the Montana ground water data base and to increase the accessibility of the ground water data for those who need it.

Missoula Valley Aquifer Study. This is a study of the ground water aquifer in the Missoula Valley by the University of Montana to assess the effects of current withdrawals and future development. The study will evaluate current water quality and potential sources and means of contamination.

4.4. GROUND WATER MANAGEMENT

Many other western states have placed severe demands on their ground water resources. These demands have resulted in conflicts requiring drastic remedial action to resolve. The primary difference between Montana and other western states has been that ground water problems of depletion and contamination have not widely occurred. Thus, Montanans have not been forced to impose widespread restrictions and expensive corrective measures on ground water use.

The state has not developed a formal ground water management strategy but it has implemented several programs to identify and address ground water quality and quantity problems. These programs can be used in the future as building blocks for a statewide ground water management strategy. The programs are directed towards quantification of water resources, control of potential sources of ground water pollution and identification and review of important issues.

The statewide adjudication process is a cornerstone to Montana's water management efforts. An accurate inventory of existing surface and ground water rights is necessary to protect present users, negotiate water compacts, plan for future developments and mitigate water conflicts. Adjudication of Montana's water rights began in 1973 with the passage of the Montana Water Use Act The act established a statewide water right adjudication program, a centralized record system and a permit system for appropriating water.

More than 200,000 claims were filed on 85 watershed basins Approximately 65,000 claims were submitted by federal agencies for water rights on U.S. Government lands in Montana. To date, final water rights

have been decreed on six basins and 38 basins have received preliminary decrees.

In 1982 Montana implemented a Ground Water Pollution Control System (MGPCS). (See Section 6.3.) The MGPCS was designed to require a permit, which means monitoring must be done at sites where concentrations of pollutants are not covered by other state permitting or oversight requirements. MGPCS permits have been issued to approximately 30 operations in Montana. Most of the permitted sites are minerals extraction operations that fall under the Small Miners Exclusion Act, and facilities which store or dispose of non-hazardous wastes on site.

In April 1982, the Environmental Quality Council (EQC), working with the Water Resources Oversight Committee and the Montana Water Resources Research Center, held the Montana Ground Water Conference in Great Falls. The conference acquainted legislators, water user groups and the general public with some of the unique characteristics of ground water, identified problems associated with its use and explained some of the requirements for ground water management and protection. The conference was an important step in formulating a ground water strategy for Montana.

In August 1982, the EQC asked the governor to appoint an advisory council on ground water issues. A sixteen-member Ground Water Advisory Council was created by Executive Order to review Montana's present ground water management framework and develop recommendations for legislation or rules that would promote the wise development and protection of the state's ground water resources.

A report prepared by the Advisory Council was published in January 1985. The report identified ground water issues facing Montana and presented options for their resolution This report will be of critical importance in guiding work on ground water issues in the years ahead. A summary of the Ground Water Advisory Council's recommendations is presented in Table 4-4.

Table 4-4. Summary of Montana Ground Water Advisory Council Recommendations

The Issues	Council's Recommendations	The Issues	Council's Recommendations
Ground Water Use Opportunities	Develop a publication to educate the public on ground water use opportunities and responsibilities.	Ground Water Quality and Quantity Interaction	Allow formation of controlled ground water area in response to water quality degradation caused by excessive withdrawals and contaminant migration.
	Form an information center for the central organization and management of all ground water data collected state-wide.	Ground Water Data and Information Needs	Support the Water Development and Legacy fund grant applications submitted by MBMG to obtain funding for the Ground Water Information Center (GWIC) during the 1986-87 biennium.
Conjunctive Surface Water and Ground Water Use	Identify opportunities for conjunctive use and establish site-specific research/data-gathering efforts to take advantage of these opportunities.		Request that the University System include, as part of its 1988-89 budget, sufficient funding to sustain the Ground Water Information Center.
	Support the U.S. Bureau of Reclamation's demonstration artificial recharge program.		
Aquifer Depletion	Identify specific areas where aquifer depletion is--or could become--a problem; and evaluate data needed to determine severity of the problem.	Statewide Assessment of Ground Water Quality	Assess statewide ground water quality in the major aquifer systems.
	Use existing controlled ground water area statutes as necessary to deal with aquifer depletion.	Spills and Underground System Leaks	Support creation of a clean-up fund for accidental spills and leaks.
Interstate/ International Ground Water Allocation	Gather data on ground water quality and quantity and characteristics of aquifer systems shared with other states or nations.		Support system requiring measures to prevent leaks and monitoring for leaks for both existing/new tanks and pipelines.
	Approach the Canadian provinces of Alberta and Saskatchewan on beginning a mutual data-gathering effort on shared aquifer systems		Support an inventory system to locate abandoned, existing and new storage tanks
Water Well Driller Qualifications	Clarify the legal distinction between water well drillers and water well contractors, require licenses for both contractors & drillers, & request that the Board of Water Well Contractors consider moving intact from the Department of Commerce to DNRC.	Ground Water Contamination from Reserve Pits	Assess the extent to which presently accepted reserve pit reclamation procedures threaten ground water quality
		Saline Seep Control	Stabilize the state's share of funding to the Triangle Conservation District.

Table 4-4. Continued

The Issues	Council's Recommendations	The Issues	Council's Recommendations
Water Well Driller Qualifications (continued)	Increase the professional staff of the Board of Water Well Contractors. Set up a continuing education program for all water well drillers and contractors operating in the state.	Hazardous Waste Disposal	Evaluate the need for--and feasibility of--developing a commercial hazardous waste collection, transport, and disposal system within the state.
Well Construction Standards	Give the Board of Water Well Contractors statutory authority to adopt comprehensive well construction standards. Adopt mandatory comprehensive well construction standards and enforcement procedures.	Interagency Coordination	Support the Ground Water Information Center as a means of avoiding duplication in data gathering. Encourage EQC to work with Montana State University's Water Resources Research Center Advisory Council for improved interagency cooperation in research data gathering. Require that a standard set of ground water data be sent to GWIC by all parties who conduct ground water studies with state money
Well Interference	Assure adequate well penetration into aquifer to avoid well interference problems. Use controlled ground water area statutes to deal with well interference problems.		

Source: The Governor's Ground Water Advisory Council. January 1985. Issues in ground water management: An evaluation of Montana's ground water policies and programs. 88 pp.

5. ISSUES OF SPECIAL CONCERN

5.1. EUTROPHICATION OF FLATHEAD LAKE

Flathead Lake is the largest natural, freshwater lake in the western United States. The preservation and recreational use values of the Flathead Lake/River Ecosystem total more than one hundred million dollars per year.*

Early in 1983, researchers reported that water quality in the Flathead drainage was being degraded at an accelerating pace.* Later that summer, Flathead Lake produced its first lakewide bloom of blue-green algae. The evidence was building that Flathead Lake was in the throes of cultural eutrophication, the rapid aging of a lake caused by human activities.

Unless forestalled, the algal blooms that accompany eutrophication will bring with them a reduction in water clarity. Views of the lake bottom through twenty or more feet of crystal clear water would become a fond memory.

Heavy blooms of floating or suspended algae may pose a threat to the health of people, pets and livestock. The blue-green alga that bloomed in Flathead Lake in 1983 and reappeared in smaller numbers in 1985 was the same species (Anabaena flos-aquae) that produced toxic blooms in recent years in Hebgen, Nelson and Canyon Ferry Reservoirs. (See Section 5.5.)

Flathead Lake residents have noticed an increase in attached algae and shoreline "slime" over the past two decades These growths may be due in part to the failure of septic tank drainfields to remove algal nutrients. A large increase in the standing crop of attached algae and rooted aquatic plants, which commonly accompanies eutrophication, may interfere with boating and swimming, cause reductions in life-giving dissolved oxygen and interfere with fish spawning.

The Flathead Lake drainage is the last major refuge in Montana for large bull trout and the westslope cutthroat trout, both highly prized native sport fishes and both designated as species of special concern by the DFWP. Adult fish of both species reside in Flathead Lake and migrate up tributary streams to spawn.

Initially, the added fertility might actually stimulate the production of sport fish in Flathead Lake, but only if the added nutrients are channeled into or "packaged" in the food items these fish prefer. Existing food chains would be upset in the advanced stages of eutrophication. This upset, together with associated water quality degradation, would reduce populations of bull trout, westslope cutthroat trout and other sensitive species, including the lake trout. Eutrophication would ultimately favor fish like suckers, peamouth and

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* Flathead River Basin Environmental Impact Study. June 1983. Final Report. Report to the U.S. Environmental Protection Agency.

squawfish, which have less exacting food habits and are more tolerant of degraded water.

Phosphorus is the nutrient that controls algae growth and the rate of eutrophication in Flathead Lake Phosphorus is a common element in igneous rocks and sediments, in precipitation, in human and animal wastes and in many laundry detergents. Only in its soluble, inorganic form (phosphate) is phosphorus "bioactive," that is, biologically available to algae and capable of stimulating algal growth. Some sources are much richer in bioactive phosphorus than others Each additional unit of bioactive phosphorus is capable of generating about 500 times its weight in algae.

Much of what is known about the sources and biological availability of phosphorus in the Flathead Basin is the result of research and monitoring conducted at the University of Montana Biological Station on Yellow Bay. This work is continuing under cooperative funding from many contributors. Interpretations of the lake's status are updated annually (See Section 6.4.2.)

Major sources of phosphorus in the Flathead Basin are: 1) point sources, 2) bulk precipitation and 3) non-point sources (Figure 5-1). Point sources -- effluents from community wastewater treatment plants -- account for about 10% of the total annual phosphorus load to Flathead Lake. Another 15% of the total load falls on the lake as rain, snow, smoke, pollen and dust. The remaining 75% of the phosphorus entering Flathead Lake comes from non-point sources, including overland runoff from developed and undeveloped lands, natural and accelerated streambank erosion and recharge of surface water by ground water, some of which has been contaminated by septic tank drainfields.

Only a fraction of the phosphorus that enters Flathead Lake is bioactive. This fraction varies depending on the source (Table 5-1) Very little of the phosphorus from runoff and erosion (5-20%) is bioactive, but virtually all of the phosphorus in domestic wastewater and most of the phosphorus in precipitation is capable of promoting the growth of algae.

Table 5-1. Estimated percent of phosphorus from point sources, bulk precipitation, and non-point sources that is bioactive and of cultural origin.

Source	Percent Bioactive	Percent of Cultural Origin
Point Sources	100	100
Bulk Precipitation	80	30(?)
Non-Point Sources	5-20*	1-10*

* A small but unknown fraction of the total non-point phosphorus load, represented by domestic wastewater from households on individual sewage treatment systems, is essentially all bioactive and of cultural origin.

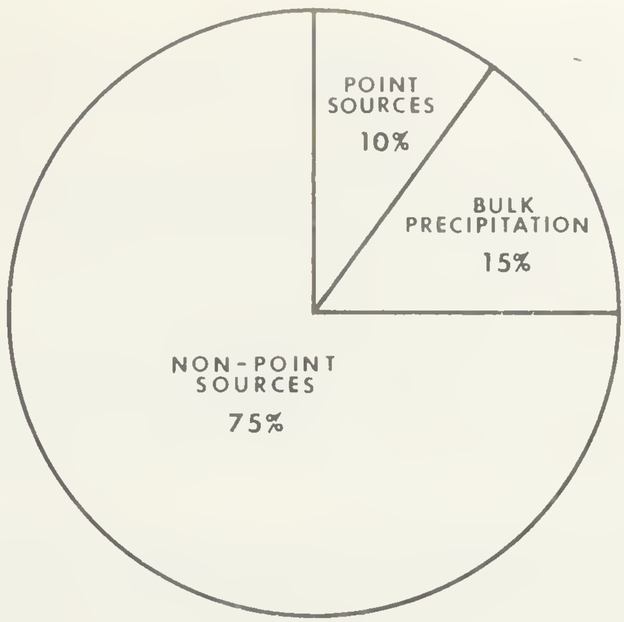

Figure 5-1. Estimated percent of the total annual phosphorus load to Flathead Lake contributed by point sources, bulk precipitation, and non-point sources of pollution.

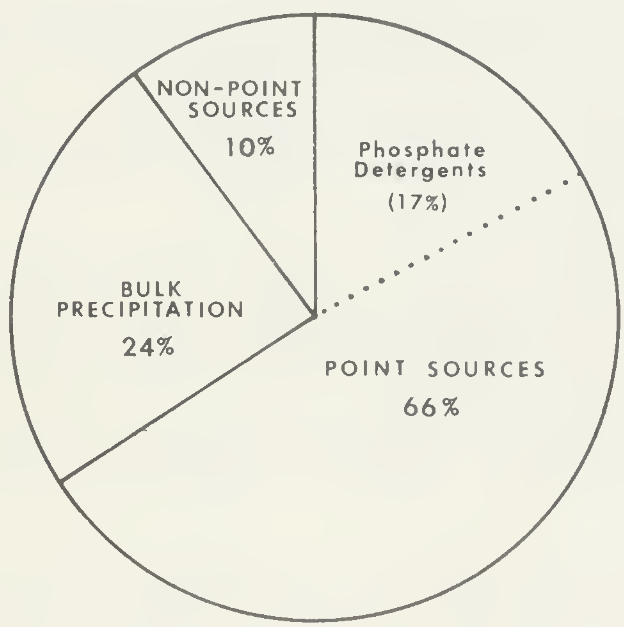

Figure 5-2. Estimated percent of the man-caused, biologically-available phosphorus load to Flathead Lake contributed by point sources, bulk precipitation, and non-point sources of phosphorus. The contribution from non-point sources is slightly underestimated for the reasons stated in the footnote to Table 5-1

At least 25 percent of the phosphorus in domestic wastewater comes from laundry detergents. About half the population in the Flathead Basin is sewered and served by central wastewater treatment systems; the other half is on individual septic tanks and drainfields. Almost all of the detergent phosphorus from the sewered population gets into Flathead Lake. A smaller, unknown amount of detergent and other phosphorus generated by the unsewered population finds its way into Flathead Lake and into other lakes in the basin.

Agricultural and forest practices, urban runoff and on-site domestic wastewater disposal have been suspected as being the most important cultural (man-caused) non-point sources of phosphorus in the Flathead Basin. Recent studies demonstrated just how important some of these sources are.

Research on the Stillwater River by the University of Montana Biological Station suggests that agricultural practices in the upper Flathead Valley generate less than one percent of the biologically available phosphorus entering Flathead Lake. Similarly, the increase in sediment and phosphorus export to Flathead Lake resulting from forest practices is probably quite small, but opening the forest canopy by logging may increase water yield and channel erosion in tributaries to the lake.

A study conducted by the Flathead Drainage 208 Project found that the phosphorus in Kalispell's stormwater runoff was only about two percent of the phosphorus measured in that city's wastewater effluent.

On the other hand, unsewered communities, subdivisions and individual households may add considerable amounts of phosphorus to local ground waters. If drainfields are set too close to lakes or streams, not properly maintained or placed in soils having inferior phosphorus-adsorption properties, contamination of surface waters will result. This phosphorus is essentially all bioactive and can be harmful to some areas along lakeshores.

On a lakewide basis, the vast majority of phosphorus reaching Flathead Lake is from non-point sources. Probably more than 90% of this phosphorus is natural, background phosphorus Conversely, a very small percentage (less than 10%) of the total non-point phosphorus load that reaches Flathead Lake is cultural, resulting from land disturbance and on-site waste disposal (Table 5-1). And, except for phosphorus from households, only a small fraction of that phosphorus can be used by algae.

When the cultural origin and bioactive potential of phosphorus sources are taken into account, the phosphorus in effluents from community wastewater treatment plants (including detergent phosphorus) is recognized as a very large pollution source (Figure 5-2).

As a blueprint for controlling the entrance of phosphorous into Flathead Lake, the DHES prepared and issued in April 1984 a "Strategy for Limiting Phosphorus in Flathead Lake." This report reviewed phosphorus impacts on the lake; identified the major sources of

phosphorus in the lake; summarized phosphorus control alternatives; and recommended a special program to reduce the amount of phosphorus entering the lake. (See Section 6.5.2.)

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5.2. CLARK FORK RIVER

The Clark Fork River (Figure 6-2) has been aptly described as the most polluted river in Montana. Compared to any other waterway in the state, the sources and kinds of pollutants are numerous and the effects far-reaching (Table 5-2).

Toxic metals, derived from more than a century of copper mining and smelting in the river's headwaters, have had a definite impact on the Clark Fork. During runoff periods, concentrations exceeding EPA ambient water quality criteria are common in the river above Missoula and have been found, at times, to occur as far downstream as Thompson Falls. Concentrated deposits of metals are evident along the upper river floodplain and within the sediments of Milltown Reservoir. Recently, sediment deposits in the lower river reservoirs have been found to contain elevated metals levels, although the concentrations are nearly an order of magnitude lower than those found in the Milltown Reservoir.

Elevated nutrient levels and subsequent nuisance algal growths are prevalent in the river above Rock Creek. Here the river's average annual discharge is approximately 4 percent of that recorded at the Idaho border, yet the stream receives domestic wastewater from three cities with a combined population of more than 50,000 people--nearly a quarter of the basin's population. Phosphorus amounts from natural sources, including a phosphoria outcrop in the Garrison/Gold Creek area, are amplified by logging, grazing, road building and mining activities.

Discharges from the City of Missoula wastewater treatment plant (WWTP) and the Stone Container Corporation (formerly Champion International) pulp and paper mill add substantial quantities of nutrients to the lower river. But the addition of the Flathead, Blackfoot, and Bitterroot Rivers, all with relatively low nutrient levels, has historically prevented the growth of algae at densities observed in the upper river. There are no major sources of nutrients between the Stone mill and the Idaho border, and concentrations generally decrease with increasing distance downstream. Algal mats are conspicuous at times between Missoula and the mouth of the Flathead River.

Recent data suggest that the lower river reservoirs act as nutrient "sinks", particularly for phosphorus. This is a benefit for Lake Pend Oreille, Idaho, which remains a relatively clear, oligotrophic lake

Table 5-2. Pollution sources and average severity index and use impairment values for seven reaches of the Clark Fork River; calculated from data on STORET collected between August 1983 and August 1985 (See Section 3.1.1. for derivation of use impairment values.)

River Reach	Estimated Length (Miles)	Number of Stations	Severity Index Values	Probable Impaired Uses*	Use Impairment Values	Potential Problem Parameters**	Principal Pollution Sources***
Warm Springs Cr. to Little Blackfoot R.	38	11	4.86	A (C)	0.25	TSS, Temp, Iron, Copper, P, pH	WWTPs, IM, U, O, IA, I, G, F
				P	2.59	Manganese, Lead, pH	
				R	1.39	P, pH	
				I	0.63	pH	
Little Blackfoot R. to Blackfoot R.	81	11	0.86	A (C)	0.55	TSS, Temp, Copper, P	Same as above plus N, HM
				P	0.26	Manganese, Lead, pH	
				R	0.05	P, pH	
Blackfoot R. to Missoula WWTP	10	4	1.22	A (C)	0.24	TSS, Temp, Iron, Copper, P, pH	Milltown Reservoir, U, O
				P	0.68	Manganese, pH	
				R	0.30	P, pH	
Missoula WWTP to Stone Container Corporation	16	5	5.04	A (C)	0.93	TSS, Temp, NH_3, Iron, N, Copper, P, pH	Missoula WWTP, U, O
				P	1.62	Manganese, Ammonia, pH	
				R	2.49	FC, P, pH	
Stone Conainter Corporation to Huson (Stone Mixing Zone)	9	6	0.95	A (C)	0.38	TSS, DO, Temp, Iron, pH	Stone paper mill, Missoula WWTP
				P	0.48	Manganese, pH	
				R	0.09	pH	
Huson to Flathead River	85	19	0.93	A (C)	0.33	TSS, Temp, Iron, pH	All of the above
				P	0.29	Manganese, pH	
				R	0.31	pH	
Flathead River to below Cabinet Gorge Dam	100	13	0.55	A (C)	0.43	TSS, DO, Temp, Iron, pH	All of the above plus Thompson Falls, Noxon and Cabinet Gorge Reservoirs
				P	0.06	Manganese, pH	
				R	0.06	pH	

* A (C) = aquatic life (cold water);
R = primary contact recreation;
P = public water supply;
I = irrigation.

** TSS = total suspended sediment;
Temp = temperature (too warm);
N = nitrogen (total);
Ammonia = total ammonia;
FC = fecal coliform.
DO = dissolved oxygen;
P = phosphorus (total);
NH_3 = un-ionized ammonia;
pH = pH too high;

*** WWTP = municipal wastewater treatment plants;
O = on site domestic waste disposal;
I = industrial discharge;
HM = hydrologic modification.
IM = inactive mining;
IA = irrigated agriculture;
F = forest practices;
U = urban runoff;
G = grazing;
N = natural;

About 85 percent of the water that enters Lake Pend Oreille originates in Montana. The amount of nutrients that could trigger open-water algal blooms, such as those that recently occurred on Flathead Lake, is unknown. The State of Idaho intends to address this question in the near future. The DHES will continue to monitor nutrient levels along the river and in the Missoula WWTP and Stone effluents. (See Section 6.4.2.)

Levels of un-ionized ammonia in the river below the Missoula WWTP periodically approach the EPA criteria for protection of aquatic life. Expansion of the city's sewered population, without any concurrent upgrading or modification of waste treatment, will likely increase the potential to exceed these criteria. The Clark Fork River above Deer Lodge and the Bitterroot River above Hamilton are dewatered by irrigation diversions during summer. These reduced streamflows increase the potential for toxic ammonia and other water quality problems below the WWTP discharges of these cities.

The upper river experiences summer temperatures that are sometimes in excess of those conducive to the growth and propagation of cold-water fish. The lower river, particularly through the reservoirs, reaches higher temperatures that probably inhibit the growth and propagation of salmonids. This condition likely contributes to the abundance of non-game fish and the paucity of trout in the lower river.

Concern about the toxicity of Stone Container Corporation's wastewater was significantly allayed by the results of chronic rainbow trout and Ceriodaphnia (water flea) bioassays conducted by the EPA during the spring of 1985. No significant mortality was found, even at a wastewater concentration double that allowed in the company's MPDES permit. The absence of measured toxicity in the lower river is further supported by instream biological data, including the presence of a diverse macroinvertebrate community. Although fishery data are limited, populations of trout, smallmouth bass and mountain whitefish are present in the lower river. (Preliminary results indicate that growth rates for the recently-planted smallmouth bass population are among the highest recorded in the U.S.)

Recent evaluations by the DFWP suggest that spawning conditions for trout in the river from Missoula to (at least) St. Regis are far from ideal. Submerged gravel bars are sparse, and bedrock outcrops and large boulders are common. This condition dictates a greater reliance on tributary streams for trout spawning and recruitment But many of the river's tributaries are impacted by sediment, much of it from roads, mines, cutover forests and overgrazed lands. Although sediment impacts in the Clark Fork drainage may not be any more severe than those of other river systems in the state (actual data are scarce, particularly measurements of in-stream sediment deposition), the fact that the river's tributaries appear to be very important for sustaining trout populations in the mainstem elevates the importance of non-point sediment impacts within the basin

Three Superfund projects are presently addressing ways to mitigate or reclaim sources of toxic metals in the upper river. A fourth site,

an abandoned pole treating plant near Butte, is in the process of being cleaned up under a Superfund emergency removal action. The DHES is conducting an extensive and intensive water quality monitoring program on the river. (See Section 6.4.2.) Comprehensive fishery investigations are being conducted by the DFWP. In total, nearly 40 state, federal and university studies are evaluating the water quality and other aquatic resources of the basin. The Clark Fork River Basin Project Coordinator, situated in Governor Schwinden's office, is coordinating and integrating the efforts of these investigations. (See Section 6.5.3.)

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5.3. DRINKING WATER

5.3.1. GROUND WATER PROBLEMS

Ground water provides water for more than 95 percent of Montana's public water supplies (PWS), but these sources serve only about 30 percent of the people who use public systems. Ground water systems have resulted in few health-related problems. Eight community systems exceed the maximum contaminant levels (MCL) for fluoride and nitrate, and two exceed the MCL for selenium. Of lesser significance are those waters that are safe to drink, but taste and smell bad. Many of the ground water sources east of the Rocky Mountains have mostly aesthetic problems associated with one or more of the following: dissolved solids, iron and iron bacteria, manganese, hydrogen sulfide gas, sodium and sulfate. In some areas the ground water quality is so poor, farms have to haul water or, with the aid of loans and grants, build extensive rural water systems.

Generally, Montana's ground water is not vulnerable to bacterial contamination. Few sources require chlorination. However, the potential for contamination is increasing with the decline of water tables caused by drought and the contamination of aquifers by petroleum products and pesticides. (See Section 4.2.)

5.3.2. SURFACE WATER PROBLEMS

Only about five percent of Montana's PWS use surface water. However, these systems provide water to about 70 percent of the people who receive water from public systems. The major concern is that many supplies have no treatment other than chlorination. This leads to violations of the MCL for turbidity and occasionally to serious health problems. Several Montana communities have reported cases of giardiasis, including White Sulphur Springs, Red Lodge and Missoula. Recently Missoula was forced to abandon its Rattlesnake Creek water supply due to an outbreak of giardiasis, and Red Lodge installed a new filtration plant to prevent the recurrence of an epidemic that affected 860 people in the summer of 1980.

Giardiasis is caused by the parasite Giardia lamblia. Giardia inhabits the small intestine of humans and other animals, and causes symptoms such as diarrhea, weakness, weight loss, nausea and abdominal cramping. It is transmitted by an individual ingesting the cyst, or dormant stage of the organism. It has become the most commonly detected cause of waterborne gastroenteritis in the United States. Cysts occur in water when infected animals excrete fecal material into lakes and streams. Several million cysts may be released at once, as few as 10 are able to cause an infection in humans. Because Giardia cysts are resistant to chlorine at low temperatures and have been found in drinking water which otherwise meets coliform and turbidity requirements, the DHES is taking a closer look at the statewide potential for Giardia problems.

The DHES has contracted with a recent graduate of Colorado State University who is an authority in the area of Giardia control. This person is evaluating Montana's PWS that use surface water to determine the incidence of Giardia and the potential for the organism to pass through the treatment facilities. Data are being compiled and interpreted to determine effective and ineffective treatment plant operations, and to pinpoint potential problems. Recommendations and assistance are provided to facilities found to be at risk in order to alleviate this threat to public health. Information on the parasite is also provided to water system operators, local government officials, local health department employees and the general public to help eliminate misinformation and to educate the public about this important resident of our surface waters.

Tastes and odors associated with algae blooms pose problems for many surface water systems. Several communities are seeking to alleviate these problems by building treatment plants or switching to ground water. Bozeman recently put in a new 10-million-gallon-per-day direct filtration plant. Red Lodge built a new water plant, as have Devon, Loma, Culbertson and Fort Peck. Helena has improved and expanded its Missouri River plant, which successfully treated a taste and odor problem in September 1984. Helena is also investigating the use of ground water and a new treatment facility in the Ten Mile Creek system. Also many non-community supplies have either abandoned their surface sources, replacing them with ground water sources, or have added filtration and chlorine or ultraviolet disinfection

5.3.3. PUBLIC WATER SUPPLY PROGRAM

The DHES has been given responsibility by the U S Environmental Protection Agency (EPA) for the administration of the Safe Drinking Water Act. The Public Water Supply Program regulates about 2060 public water supplies (PWS) of which approximately 650 are community systems One of the most important aspects of the program is to insure that all public water systems are monitored on a regular basis for bacteriological, radiological, chemical and physical contaminants The results of this monitoring are then reviewed to be sure that the water served to Montana's public is reasonably safe for human consumption. Also, the DHES conducts sanitary surveys of all PWS on a regular basis. The findings of the sanitary surveys are used to see that necessary

improvements are made to existing systems to reduce or eliminate any public health hazards that are discovered.

Montana law also requires the department to review plans and specifications for all construction proposed for both PWS and public sewer systems. This takes up considerable staff time. The DHES has incorporated the "Ten States Standards"* as a part of the Montana rules They are used as minimum design standards for community systems. The department has written its own design standards for noncommunity systems.

Montana's Public Water Supply Program has changed markedly since receiving primacy from EPA in 1977. The program now regulates and monitors about seven times as many PWS as it did nine years ago. Funding for the program has not kept up with the steadily increasing responsibilities, and over the past few years there have been cutbacks in staff. This means the program has to accomplish more with fewer resources. Over the past few months the Water Quality Bureau has purchased a networking system of IBM Personal computers that should save staff time. The system includes six computers, two printers, standard word processing and spread sheet software and a networking data base called "Revelation". Also the program has received system-specific software that was developed by the State of Alaska for its Public Water Supply Program. That software is currently being put on the newly purchased hardware system and will be operational for limited use by the spring of 1986.

It is expected that it will be nearly a year before all program data and reporting functions will be handled by the new system. At this time the program is utilizing the word processing capabilities of the new system and has found it to be more than satisfactory. If the data processing and reporting functions work satisfactorily, the system will greatly strengthen these recognized weaknesses in our program.

Program staff interact daily with public and private water system personnel as well as with the press and concerned public to help solve a wide array of problems. These problems include system contamination, equipment failure, floods, taste and odor complaints, operator training needs and proposed construction on new and existing systems.

Over the past few years more emphasis has been placed, by both EPA and the state, on enforcement actions against systems that are found to be persistent violators of the regulations (See Section 6.1.3.2.). A number of PWS have been taken to court to seek compliance with state and federal requirements. The enforcement actions have been vigorously pursued by the department, which has been nearly 100 percent successful in achieving compliance by the targeted systems. EPA Region VIII has recognized the Montana Public Water Supply Program as a leader in the area of enforcement. The program's legal support has recently been

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* Great Lakes-Upper Mississippi River Board of State Sanitary Engineers. 1978 and 1982. Recommended Standards for Sewage and Water Works. Health Education Service Inc., Albany, New York.

reinforced by additions to the department's legal unit and it is expected that this will enable the Program to make even greater strides in the enforcement area.

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5.4. ACID DEPOSITION

Acid deposition has been identified as one of our nation's high priority pollution problems. Gaseous sulfur dioxide and nitrogen oxides, originating principally from the combustion of fossil fuels and the metals smelting industry, undergo complicated changes in the atmosphere to form sulfuric and nitric acids. These materials may be carried hundreds of miles from their source, eventually falling to the earth in the form of acidic rain or snow, or even as dry material. Because of the various forms in which acids return to the earth, the term acid deposition is more appropriate than acid rain.

Most of the concern over acid deposition in North America has focused primarily on areas downwind from major industrial centers in the eastern United States and Canada. In the Adirondack Mountains, for example, several hundred lakes have been acidified to the extent that they no longer support fish life. Typically, an increase in lake acidity results in a shift from acid-sensitive to acid-tolerant forms of life. Such a shift is usually accompanied by a decrease in the recreational quality of the lake

There is an increasing body of evidence demonstrating that acid deposition is also occurring in the western United States. Snow surveys conducted for the last several years in western Montana show that snow falling in the southwestern corner of the state commonly has a pH between 4.0 and 5.0. Snow or rainfall having a pH of less than 5.6 is suspected of being acidified by man-caused activities. Rainwater in equilibrium with natural atmospheric gases, such as CO_2, has a pH of about 5.6. However, methods for tracing the sources of atmospheric acids have not reached the level of sophistication necessary to identify with certainty where Montana's acid deposition originates

Not all natural waters are equally sensitive to acids. In fact, many waters contain ingredients that render them virtually immune to acid deposition. This important quality of water is called alkalinity (also referred to as buffering capacity) and is derived from the weathering of limestone rocks. Thus, waters overlying or draining geologic formations that contain limestone, the Madison River for example, are relatively insensitive to acids. On the other hand, geologic materials such as granite have no innate ability to buffer

acids. In Montana many of our most sensitive waters are alpine lakes overlying granitic basins.

The acidification of lakes is a relatively slow process and requires many years, perhaps decades, of monitoring in order to document whether change has occurred. Montana has only recently begun to collect the baseline information necessary to gauge future changes in lake acidity.

Information on the alkalinity of lakes in Southwestern Montana mountain ranges is summarized in Table 5-3.

Table 5-3. Relative sensitivity to acid deposition of 62 alpine lakes in four Montana mountain ranges. Rating scheme developed by EPA and based on total alkalinity of surface waters.

		Sensitivity category (alkalinity range, mg/l as $CaCO_3$)				
Mountain Range	Number sampled	Critical (<2)	Endangered (2 - <5)	Highly sensitive (5 - <10)	Sensitive (10 - <20)	Not sensitive ($\geq$ 20)
Beaverhead Mountains	15	1	3	7	4	0
West Pioneer Mountains	9	0	5	2	0	2
East Pioneer Mountains	18	0	2	8	4	4
Spanish Peaks	20	0	3	6	11	0

This information does not tell us whether Montana lakes have already become more acidic; however, it does indicate that many of the state's lakes are extremely sensitive to acid deposition. It is encouraging to note that no Montana lakes have been found that have entirely lost their buffering capacity.

Additional baseline information was collected during the Fall of 1985 by the EPA and the USFS in a number of western states. This study

is part of the National Surface Water Survey which has been designed in three phases to assess the impact of acidic deposition on aquatic resources. The three study phases are:

1) Quantify the chemistry of lakes and streams in regions of low alkalinity throughout the U.S.

2) Quantify the biological components and seasonal variability of regionally representative lakes and streams.

3) Initiate long term monitoring of lakes and streams representative of major geographical regions of the U.S.

Eighty (80) lakes were sampled in Montana by the EPA and the USFS during Phase I of the study. The results from Phase I are expected to be available in mid-1986.

It is important that the DHES and others continue to monitor trends, since acid deposition is occurring and highly sensitive waters are present.

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5.5. TOXIC ALGAE

In the last week of June 1985, Montana had its fourth documented case of toxic blue-green algae. This one was a repeat performance in the Grayling Arm of Hebgen Reservoir near West Yellowstone. Seventeen head of cattle died where 39 had perished eight years earlier.

Toxic algae have been recorded at Hebgen Reservoir (June 1977 and 1985), Nelson Reservoir (July 1980) and Canyon Ferry Reservoir (August 1984). All four episodes occurred in years of drought; all four were detected when dead cattle were found in and near water containing a bloom, and all four were caused by the same species of blue-green algae: _Anabaena flos-aquae_.

When most algae bloom they're nothing more than a nuisance. They can foul fishing lines, produce an ugly scum on the surface of a lake or create unpleasant tastes and odors in drinking water. But when blue-green algae bloom, they can do these things and more: they can kill.

Blue-green algae are among the oldest and most primitive of all life on earth. Blue-green algae are sometimes called Cyanobacteria, after the bluish pigment (phycocyanin) they produce and their primitive bacteria-like features. But because they are capable of photosynthesis, they are most commonly grouped with the algae rather than with the bacteria.

The prefix "Cyano-" from the word Cyanobacteria has led some laymen to believe that the toxic agent produced by these algae is a form of cyanide. This is not true.

Montana, along with the northern tier of states and the southern fringe of the Canadian provinces, has the dubious distinction of being included in the Blue-green Algae Belt. Here the hard waters, warm summer temperatures and nutrient-rich soils combine to produce conditions ideal for blue-green algae blooms.

Although blue-green algae are common in Montana's rivers and creeks, only standing bodies of water--lakes, ponds and reservoirs-- can produce blooms of the potentially toxic species. The surface water must warm to 68^{o}F or higher before a bloom can occur, which explains why blooms appear only in summer and often begin in shallow bays where water is heated more rapidly by the sun.

Some blue-green algae can "fix" molecular or gaseous nitrogen, much as peas and beans do, hence they are less dependent on the ions of this nutrient dissolved in the water. They are also more efficient than other algae at using very small concentrations of phosphorus in water. Bluegreens can form dense surface scums that shade other algae, and they are relatively free from grazing by aquatic animals. Thus, the bluegreens have several competitive advantages over other algae.

Three potentially toxic species of blue-green algae are found in North America and in Montana: Anabaena flos-aquae, Aphanizomenon flos-aquae and Microcystis aeruginosa. Blooms of these algae look like pea soup, green latex paint, chopped hay or grass clippings that someone has dumped into the water.

Fortunately, toxic strains of these algae are rare, but there's no way to predict when and where they will appear. The genetic or environmental factor that triggers toxin production is unknown. Toxic and nontoxic strains can exist side-by-side in the same lake, and a toxic strain can appear where a harmless strain or no algae at all existed only a day or two before. It can also disappear just as quickly.

A common question asked during toxic algae blooms is "How do you tell a toxic strain from a harmless one?" They look the same, even under a microscope. The only way to tell for sure is to collect some of the algae and inject a small amount into a laboratory mouse. If the mouse dies, it's toxic; if the mouse is alive after 48 hours, it's probably not toxic.

Wayne W. Carmichael of Wright State University in Dayton, Ohio, is a world authority on toxic freshwater blue-green algae. At a 1980 international conference on algal toxins and health, Carmichael summarized what is known about the subject:

> Of about 12 toxins produced by virulent strains of the three potentially-toxic species, only one has been identified and synthesized and its toxicology determined. When waterblooms of

toxic strains are present, the cells and toxins can become concentrated enough to cause illness or death in almost any mammal, bird or fish that ingests enough of the toxic cells or extracellular toxin. Major losses of animals include mainly cattle, sheep, hogs, birds (domestic and wild) and fishes while minor losses are reported for dogs, horses, small wild mammals, amphibians and invertebrates. Acute toxicity to humans has not been documented, but there is increasing evidence that the toxins cause gastroenteritis and contact irritation.

Anabaena flos-aquae produces one of the most deadly of all toxins known to man. Before its molecular structure was determined, scientists simply called it the "very-fast-death factor." The alkaloid toxin produced by certain strains of this species can kill a laboratory mouse in minutes and a full-grown black angus bull in less than an hour. The toxin has a neuromuscular effect: it prevents the nervous system from signaling the muscles to function; the breathing apparatus shuts down and the animal suffocates; a very rigid neck is characteristic at death. Symptoms include staggering, muscle spasms, labored breathing and convulsions. In people who unwittingly ingest the toxins, sensations of numbness, dizziness, tingling and fainting may be manifest. And there is no known antidote.

The other major types of toxin produced by blue-green algae are polypeptides and polysaccharides, which debilitate their victims by breaking down internal tissues. One tell-tale sign in surviving animals is cirrhosis of the liver. Symptoms include nausea, vomiting, severe thirst, diarrhea and lethargy. These toxins have caused outbreaks of gastroenteritis when ingested from municipal drinking water supplies.

There have been no human deaths reported from toxic waterblooms. This is not because people aren't susceptible, but because most people simply would not think of drinking water directly from a bloom. Does this mean that blooms are safe to swim in? Not necessarily.

First, you can't tell just by looking at it whether a bloom is toxic. And nearly everyone from time to time will inadvertently gulp some water while swimming. Children, who are more susceptible because of their low body weight, are even more prone to take on some extra water while swimming or playing at the beach.

When people come in contact with a waterbloom, chemicals produced by Cyanobacteria can cause allergic responses such as rashes and hayfeverlike symptoms. These responses may vary in intensity from person to person, just as people may be more or less sensitive to certain kinds of pollen. In animals, ingestion of water containing blue-green algae pigments can make exposed or light-colored skin much more sensitive to sunlight, causing blisters and peeling.

Blue-green algae toxins are not known to concentrate in fish. Even fish that have been killed by blue-green toxins probably have not been exposed long enough to accumulate a lethal dose for humans who eat them. Vigorous fish caught on hook and line should be safe to eat, although they may taste "weedy" if taken in or near a waterbloom

As waterblooms break apart, the decomposing algae will not generate much oxygen through photosynthesis and the process of bacterial decomposition will take considerable oxygen out of the water. Even in a healthy condition, algae in a massive waterbloom will respire enormous amounts of oxygen at night. This can create a localized depletion of dissolved oxygen, which may be just as deadly as algal toxins to fish and aquatic life.

Toxic blooms are rare, but they're probably not as rare as one might think. Four cases have been confirmed in Montana only because livestock happened to be watering at the exact location and at the precise instant of a toxic waterbloom. How many others have gone undetected? Perhaps dozens, even hundreds.

Waterblooms are a fact of life in Montana. They can occur anywhere and at any time from May through October. Heavy concentrations of blue-green algae should be presumed toxic until proven otherwise. People should avoid waterblooms and keep children, pets and livestock away. This is good advice at any lake in Montana.

Plans are being made to monitor and study blooms of blue-green algae during the summer of 1986. A conference titled "Blue-green Algae Toxicity in the Greater Yellowstone Ecosystem and the Upper Missouri Drainage" was held in Bozeman in February. Dr. John Priscu, a limnologist from Montana State University, will study factors this summer that contribute to algae blooms on Canyon Ferry Reservoir. And, government personnel will be on the lookout for dense concentrations of algae on public lakes and reservoirs, especially those that have had toxic blooms in the past.

For more information about toxic waterblooms, write the Water Quality Bureau, Montana Department of Health and Environmental Sciences, Room A-206, Cogswell Building, Helena, Montana 59620. The Department also will provide free analyses of waterblooms for the presence of potentially toxic algae.

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5.6. GAS ENTRAINMENT

There are a number of locations in the western United States, particularly below dams with spillways, where surface waters have become supersaturated with dissolved gases. Plunging of the water below dams causes air (composed primarily of nitrogen and oxygen) to become entrained resulting in the supersaturated conditions. If gas

supersaturation becomes excessive, usually above 110% of normal, fish and other organisms that live in water may become sick. The terms used to describe this condition are gas bubble disease or gas bubble trauma The disease is characterized by bubbles forming in the tissues and blood vessels of the fish, hence the term gas bubble disease. In effect, bubbles are formed because the pressure of the gases present in the fishes' blood and tissue is greater than the compensating pressure provided by the atmosphere and the overlying water. The condition is analogous to a scuba diver suffering "the bends," which can occur when one moves too quickly from deep to shallow water.

Fish can compensate for supersaturated conditions by seeking water of greater depth. Each meter of depth provides a compensating pressure that is equivalent to about one-tenth of that provided by the atmosphere. Unfortunately, rivers are often too shallow to provide effective compensation; moreover, certain fish must move into shallow areas to carry out essential activities such as feeding and spawning.

Supersaturation of dissolved gases has long been known to create problems below large dams on the Columbia River in Oregon and Washington. However, only in the last 15 years has information been collected describing the problem on Montana rivers. Fish exhibiting symptoms of gas bubble disease have been observed in the Kootenai River below Libby Dam, the Beaverhead River below Clark Canyon Dam, the Missouri River below Hauser Dam and the Bighorn River below Yellowtail Afterbay Dam.

The problem at Libby Dam was temporary and occurred during a brief period of spillage over the dam prior to activation of the power plant. The problems below Hauser and Clark Canyon Dams also occur infrequently and appear to be correlated with unusually high flow conditions.

The most severe gas entrainment problem in Montana exists in the Bighorn River below Yellowtail Afterbay Dam. Gas bubble disease in trout from the Bighorn River was first observed in 1973. Subsequent studies have shown that 1) fish are affected primarily in the first five miles of river below the dam, 2) brown trout show a higher frequency of symptoms than rainbow trout and 3) larger brown trout (those over 17 inches) are more severely affected than smaller brown trout.

The Bureau of Reclamation attempted to alleviate the gas entrainment problem in 1982 by installing deflector plates on the face of the spillway to prevent the water from plunging into the stilling basin. However, turbulence created by this modification caused rocks to be pulled into the stilling basin which threatened to erode away the base of the dam. Because of this problem, the deflector plates were removed in the summer of 1983.

There are presently several parties interested in retrofitting the dam with a turbine to generate electricity. This would ultimately solve the gas entrainment problem because plunging water would be eliminated. However, the prospects for this occurring in the next several years are unlikely. In the meantime, the Cooperative Fishery Research Unit at Montana State University and the Montana Department of Fish, Wildlife

and Parks have initiated a study to try and gain a better understanding of the relationship between operation and design of the dam and gas bubble disease, and of the ecological factors that cause certain species and ages of fishes to be more susceptible than others.

Objectives of the study are:

1. To relate fish population levels and seasonal mortality to gas bubble disease incidence and dissolved gas saturation levels;

2. To determine survival rates and factors controlling survival of early life history stages of both brown and rainbow trout in the Bighorn River;

3. To relate gas bubble disease incidence to ambient conditions, including gas saturation levels, flow rates and reservoir operations;

4. To determine if different species or life stages of trout partition themselves in the environment in such a way as to influence their susceptibility to gas supersaturation;

5. To determine the relative success of anglers in catching diseased vs. healthy fish in order to assess the impact of gas bubble disease on the fishing public;

6. To examine the incidence of gas bubble disease for various life stages and species at varying water depths and for different river reaches;

7. To determine the ability of brown trout to recover from gas bubble disease after acquiring symptoms of varying degrees of severity, and to assess the influence of water temperature on rate of recovery;

8. To determine what mechanisms (physiological or otherwise) result in brown trout having a higher incidence of gas bubble disease than rainbow trout in the Bighorn River, and to determine what dissolved gas saturation levels are safe for each of these species, and

9. To assess the impacts of gas supersaturation on invertebrates and forage fish in the Bighorn River.

It is clear from work conducted to date that there are many aspects of gas entrainment problems that are poorly understood. The studies conducted on the Bighorn River should put us in a better position to deal with gas entrainment problems wherever they may occur.

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5.7. FREEZEOUT LAKE/TETON RIVER SALINITY

Freezeout Lake is a waterfowl refuge of approximately 16,000 acres managed by the DFWP. It serves as a sink for irrigation return flows and drainage from a large irrigation project. Evaporation exceeds precipitation in the area, thus concentrating salts in Freezeout Lake The only outlet from the brackish refuge is through an adjacent lake system (Priest Butte Lakes) to the Teton River. In the past, saline water was released from the lake system to maintain water levels in the refuge for optimum production of ducks and geese Little consideration was given to the water quality of the Teton River downstream. Salinity in the Teton River reached levels (several thousand micromhos) that severely impaired irrigation uses.

To address this problem the DHES, in cooperation with the DFWP, developed a water quality management plan for Freezeout Lake and the Teton River. (See Section 6.4.5.) This plan included a water release system to minimize adverse impacts to the Teton River and a monitoring program. Lake discharge and Teton River flow measurement devices were installed. Flow and specific conductance levels were measured in the discharge and the river over a period of time. Water was released from Freezeout Lake to maintain downstream Teton River salinity levels below 1,000 micromhos per centimeter.

The water quality management plan was implemented by DFWP and DHES in early 1984. The DHES performed monitoring during 1984 and 1985 to evaluate the effectiveness of the plan and to document improved water quality conditions. Salinity levels in the river from June 1, 1984, through the end of the irrigation season averaged 914 micromhos. In 1985, levels were again less than 1,000 micromhos. This improvement was recorded despite a severe drought in the area which reduced Teton River dilution flows. Prior to implementation of the management plan, such low Teton River streamflow conditions resulted in salinity levels approaching 4,000 micromhos.

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5.8. PRICKLY PEAR CREEK

Prickly Pear Creek rises in the mountains south of Helena and follows a 40 mile course through mountain valleys and the broad Helena Valley prior to its confluence with Lake Helena and the Missouri River The creek is relatively small with an average annual flow of 48 cubic feet per second (cfs). It has been degraded by a variety of point and nonpoint sources of pollution. The headwaters and headwater tributaries have been impacted by acid mine drainage and heavy metal toxicity The stream channel for most of the stream's length has been destabilized by man's activities. Overgrazing, removal of riparian vegetation and stream channelization from highway and railroad construction have

aggravated streambank erosion. These activities have contributed large quantities of suspended sediment to the stream, adversely impacting aquatic habitat. The lower reaches are degraded by irrigation withdrawals, which dewater certain segments and may cause elevated temperature in others. Discharges from two municipal wastewater treatment plants also impact the lower reaches of Prickly Pear Creek and cause ammonia toxicity problems.

In an effort to address these problems the Jefferson and Lewis and Clark conservation districts hired a consultant to prepare a stream corridor management plan. The conservation districts received Section 205(j) water quality management funds from the DHES. The stream corridor management plan was completed in April 1984. It consisted of an analysis of the existing pollution problems and of potential solutions. A series of management recommendations were proposed. Cost estimates for site-specific treatments were prepared. Sources of assistance and funding to implement the management recommendations and treatments were identified. The conservation districts received $100,000 through the Renewable Resources Development program for plan implementation, and other efforts to secure assistance and funding to implement plan recommendations continue.

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5.9. MUDDY CREEK

Muddy Creek is a tributary of the Sun River, which joins the Missouri River at Great Falls, Montana. The creek drains approximately 314 square miles of agricultural land. Muddy Creek has one of the worst erosion problems in the state. It contributes more than 200,000 tons of sediment to the Sun River/Missouri River system annually.

A Bureau of Reclamation sponsored water development project constructed in the 1920's resulted in the importation of large quantities of irrigation water into the Muddy Creek drainage basin. The imported irrigation water converted a dryland farming area into irrigated cropland. The Muddy Creek basin presently supports a large irrigation project and 50,000 irrigated acres.

Muddy Creek's original unsubsidized flow of 10,000 acre-feet has been increased approximately tenfold by uncontrolled irrigation return flows and sudden releases of excess canal flow during rainstorms. The excess water has created a severe streambed and streambank erosion problem. Muddy Creek sediments have severely impacted the fishery and recreational values of the Sun River, increased flood damages and accelerated the silting in of downstream Missouri River hydropower reservoirs.

The Muddy Creek Project was organized to address the problem in 1978 as a cooperative venture of the Cascade and Teton County conservation districts and other resource agencies. An executive board of local landowners and a coordinator managed the project. Efforts consisted of: 1) Soliciting funds for planning and implementation of pollution control measures and improved agricultural management practices; 2) searching for and coordinating technical assistance activities, and 3) providing information on water conservation practices to local irrigators. Irrigation ditches were lined with concrete to reduce losses. Flood irrigation systems were converted to sprinklers and land was leveled to reduce runoff. Information on improved irrigation scheduling techniques was distributed. An automated flood irrigation system was developed to improve irrigation efficiency and reduce runoff. A preliminary plan to construct a canal system and off-stream storage reservoir to contain and regulate excess irrigation return flows was developed. A stream bank inventory to identify the most unstable stream channel areas was conducted.

A difficult farm economy, inadequate USDA cost-share funds and incentive policies and rising electric rates for sprinkler irrigation have limited widespread implementation of improved water conservation practices by farmers in the basin. However, significant improvements in irrigation water delivery efficiency have been reported. And significant reductions in Muddy Creek annual flows were recorded in 1984 and 1985. It is too early to conclude that this streamflow reduction is directly attributable to project efforts. A longer period of record will be necessary to demonstrate whether this is a meaningful long-term improvement.

Unfortunately, the search for funding to continue a coordinated Muddy Creek Project effort failed in early 1985. A search for a new focus and direction to address the erosion problem, however, continues. Future efforts may be directed at improving riparian vegetation in the lower sections of the creek. A Muddy Creek Final Project Report, prepared in January 1985, is available. This report provides a detailed background and description of project activities.

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5.10. SALINE SEEP

Saline seep is a phenomenon that degrades surface and ground water quality in the northern Great Plains. It results from a combination of geology, climate and agricultural land use patterns. The major change in agricultural land use in the northern Great Plains in the last 50 years has been the conversion of native rangeland to dryland farming, using summer fallow to conserve soil moisture. Native range vegetation uses precipitation 14 months out of a 24 month cycle, while small grains in a crop-fallow rotation only use precipitation for 3-5 months out of

this 2-year period. This allows water to percolate down beyond the root depth of small grains. As this water moves downward it dissolves and accumulates salts present in the soils. These salts had not been leached out since the arid climate and native range vegetation prevented water from moving down. Upon reaching an impermeable layer (for example, shale or bentonite) the salinized ground water moves laterally. In Montana such seeps have salinized previously fresh ground waters and surface waters. Thousands of acres of agricultural land have been salinized and lost to production. In general, the concentrations of total dissolved solids (TDS) in ground waters at seep discharge sites in Montana range from 15,000 to 55,000 mg/l.

The State of Montana addressed the problem of saline seep in 1979 by establishing and funding a consortium of conservation districts in dryland farming areas. This consortium is called the Montana Salinity Control Association (formerly the Triangle Conservation District). The impetus for the establishment of the Association resulted primarily from concern regarding lost agricultural production. Improvement of surface and ground water quality, however, has also been a benefit of the program. The Association uses a multi-disciplinary team approach to provide information to landowners and to assist farmers in developing farm management plans. The typical farm management plan involves soil analysis, well drilling, and ground water sampling to locate saline seep recharge areas, and establishment of a cropping program that generally includes deep-rooted perennial crops, such as alfalfa, in recharge areas to use excess moisture and reduce seep flows. Several hundred farm reviews have been carried out to date, and approximately 10,000 acres of salinized land have been improved. The water quality benefits of Association activities have not been quantified.

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5.11. CUMULATIVE IMPACTS ON MULTIPLE OWNERSHIP FOREST WATERSHEDS

Much of Montana's highest quality surface waters exist in its forested mountainous watersheds. There has been increasing concern that gradual long-term deterioration is occurring in these watersheds. There is particular concern that forest resource development is encroaching more and more on the steeper more sensitive headwater areas, thus threatening the highest quality streams. Federal land management policies that stress resource development, and agencies that provide inadequate budgets for watershed rehabilitation and water quality monitoring, are reasons for added concern. Watershed management must be integrated with timber and resource development to avoid long-term water quality degradation. Watershed management is particularly difficult when watersheds have many owners. Multiple ownership patterns, however, are quite common in many of Montana's watersheds. The impacts of activities which do not appear significant when viewed independently, can be quite severe cumulatively. Maintenance of high water quality in

such watersheds requires an integrated and cooperative effort by all forest owners.

The Division of Forestry, Montana Department of State Lands (DSL), has developed an initiative to improve cooperative forest watershed management in Montana. The division has drawn together a task force of state, federal and private forest managers to improve coordination of land management activities in order to limit watershed impacts in watersheds owned by two or more parties. Several alternatives have been proposed to address this issue. These include: 1) A cooperative agreement among the principal land owners outlining procedures for information sharing, watershed assessment and conflict resolution; 2) coordinated resource management planning with an institutional approach to allow management by committee agreement on individual watersheds; and 3) a common interest watershed approach to management on an individual watershed basis, through Best Management Practices (BMP), with only watershed landowners participating. The Cumulative Watershed Impacts Task Force continues to meet to further develop cooperative watershed management procedures.

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5.12. POWDER RIVER SALINITY

The Powder River salinity problem results in part from discharges of Wyoming oil field production water into the Powder River. The Salt Creek oil field in Wyoming's Powder River Basin contains 44 oil production water surface discharges, which flow continuously. Nine of these discharges have flows exceeding 1 million gallons per day. John Wagner of the Wyoming Department of Environmental Quality estimated that 28 percent of the salt load in the Powder River at the Montana border results from these oil production water discharges. The salinity levels in the Powder River at the border (1,000-2,000 milligrams per liter total dissolved solids) render the water unusable for irrigation.

Most of the Wyoming oil production water discharges began more than 20 years ago. Relatively good quality ground water is used in the Salt Creek oil field to enhance oil recovery. This water, taken from a depth of about 5,600 feet, is hot (180-200^{o}F). It is injected into the Salt Creek oil bearing formation. The water, which cools, is discharged on the surface. The quality of this water is good enough for livestock and wildlife, but not for most other uses. In many cases, the discharges provide the only perennial surface water flows in the area.

The importance of the Powder River to the agricultural community and the overall economic stability of Powder River County cannot be overestimated. Irrigation has made it possible to provide water to 15,000 acres in Powder River County alone.

The Wyoming discharges generally contain 2,000-5,000 milligrams per liter of total dissolved solids. They do not, however, violate Wyoming discharge limits, nor do they violate Wyoming Water Quality Standards. Neither Wyoming nor Montana have numerical instream water quality standards for total dissolved solids. But, Montana's standards do state that, "...degradation which will impact established beneficial uses will not be allowed."

The State of Montana considers that salt loads resulting from Wyoming's surface discharges of oil production water impair the beneficial use of Powder River water for irrigation. It therefore considers that Montana Surface Water Quality Standards are being violated.

The State of Wyoming has also been investigating further development of water resources in the Powder River Basin. Reservoirs are being proposed that would store better quality water for use in Wyoming while passing poorer quality water downstream to Montana. Montana's review of Wyoming's plan for these proposed reservoirs led Montana authorities to recognize that salinity levels in the Powder River have increased over the years. The U.S. Geological Survey has indicated that a five-fold increase in chloride ion concentration has been observed in the Powder River since 1950 An investigation into the underlying causes of the increasing salinity in the Powder River led Montana officials to identify oil production water discharges in the Salt Creek oil field in Wyoming as the source of part of the present salinity.

Montana officials recognize the desire by Wyoming land owners to have surface water for stock and wildlife watering They question, however, the need for the total volume of discharge (many million gallons per day) taking place. They feel these discharges exceed that necessary for livestock and wildlife watering.

Montana members of the Powder River Management Plan Negotiating Team are working with Wyoming counterparts in an attempt to reach a common understanding of the problem and possible mitigating measures In addition, the Powder River Conservation District is funding water quality studies designed to quantify the effects of increased salinity in the Powder River on crop yields.

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6. WATER POLLUTION CONTROL PROGRAMS

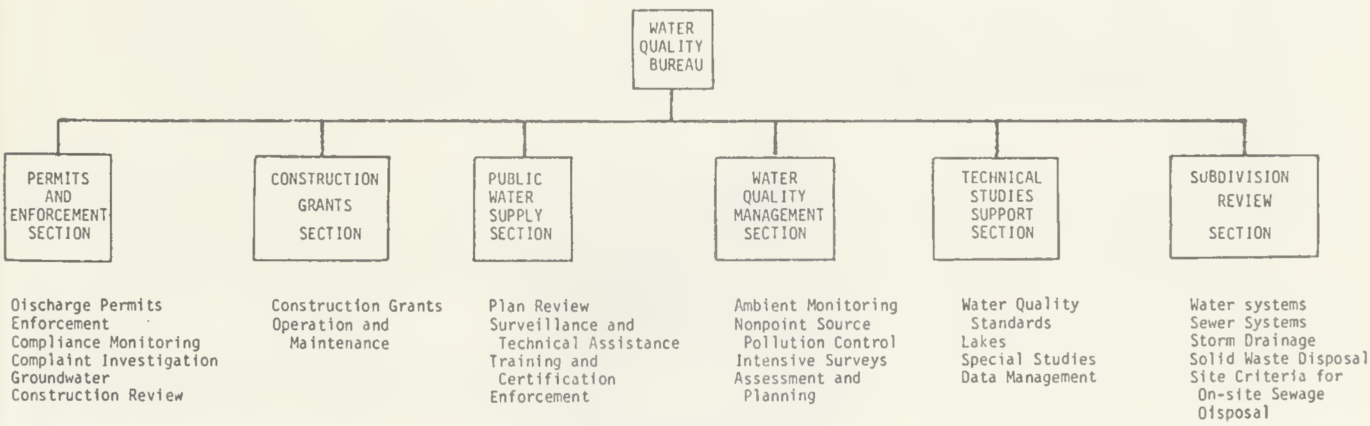
There are two basic components of Montana's water pollution control program: prevention and correction.

Efforts to prevent water pollution are, at best, taken for granted and, at worst, maligned and obstructed by those who see them as threats to development and economic prosperity. On the contrary, as is the case with any renewable resource, maintaining a quality resource base is essential to long-term productivity.

Clean water is required for agriculture and for recreation-based tourism, two of Montana's largest industries. Livestock, wildlife, fish and irrigated plants are not the only living things that need ample supplies of unpolluted water. Certain supplies must be maintained at the highest level of purity to protect the health of the state's citizens and visitors.

There is a large backlog of water quality problems in Montana. Most of them date back to an era of resource exploitation before laws were enacted to protect the environment and before the relationship between a clean environment and human health and prosperity was understood. Most of these problems are identified in the Appendix. Efforts to correct them are shared by many government agencies and citizen groups, but continue to be hampered by a severe shortage of planning and implementation funds.

This chapter describes the water pollution control programs of the DHES and others. Brief reports are given on status, accomplishments, problems and objectives of each program. The DHES is not alone in these efforts; there are similar programs at all levels of government to accomplish many of the same water quality goals. But the DHES is the primary agency responsible for administering and enforcing state and federal water pollution control and water supply laws



PRIMARY RESPONSIBILITIES FOR THE WATER QUALITY BUREAU, DHES

6.1. POINT SOURCE CONTROL PROGRAMS

6.1.1. CONSTRUCTION GRANTS PROGRAM

The Construction Grants Program has remained a major impetus in the construction of municipal wastewater treatment facilities in 1984 and 1985. The projects in Table 6-1 were completed during this period.

Water quality improvements are anticipated in all streams receiving wastes from upgraded or new treatment facilities. Frequently in Montana the volume of discharged wastewater is small in comparison to the flow of receiving streams, hence stream use impairment may not be readily detectable. Of the projects listed above, probable use impairment has been noted for streams receiving wastes from Kalispell, Bozeman, Deer Lodge, Ronan and Dillon.

In most cases it was not the municipal effluent alone that was causing the stream degradation, but a combination of pollutant sources. Before and after studies have been done on five construction grants projects, with four of the five still underway. (See Section 6.4.4.) The completed study for Bozeman indicated a significant water quality improvement in the East Gallatin River after completion of the treatment facility.

The majority of work in Montana's Construction Grants Program is now directed towards design and construction, with the bulk of the projects to be completed in 1986 and 1987. Few new facilities are being planned.

The implementation of a phosphorus limit on all municipal treatment works discharging to the Flathead Lake drainage basin has led to a flurry of construction grants activity in this area. (See Section 6.5.2.) All discharging communities, including Kalispell, Whitefish, Columbia Falls and Bigfork, are designing facilities to remove phosphorus. The unsewered community of Lakeside will be constructing a new collection and spray irrigation treatment system.

Sewering the Lakeside area will reduce the amount of phosphorus entering the lake in septic tank effluents. Plans are being prepared for the Evergreen and Whitefish Lake areas to evaluate and reduce the effects of these unsewered communities on area ground and surface waters.

The Construction Grants Program has promoted the land application of sewage sludge to enhance agricultural production. Several sludge management plans have been funded to develop consistent and appropriate sludge management practices throughout the state.

Currently eight communities are applying sewage sludge to agricultural lands. Limited compliance monitoring is being conducted by

Table 6-1. Municipal wastewater treatment plant construction projects completed in 1984 and 1985

Municipality	Project Type
Bozeman	Treatment Plant Upgrade
Chester	Treatment Plant Upgrade
Chinook	Treatment Plant Upgrade
Deer Lodge	Treatment Plant Upgrade
Dillon	Treatment Plant Upgrade
Ennis	Treatment Plant Upgrade
Geyser	New Collection and Treatment System
Great Falls	Interceptor
Hamilton	Treatment Plant Upgrade
Kalispell	Sludge Handling Facility
Manhattan	Treatment Plant Upgrade
Moore	New Collection and Treatment System
Power-Teton	New Collection and Treatment System
Shelby	Treatment Plant Upgrade
Sunburst	Treatment Plant Upgrade
Three Forks	New Treatment Plant

sludge generators through the Montana Pollution Discharge Elimination System (MPDES) permit program to assess adherence to approved sludge management plans. It is anticipated that expanded regulatory review by DHES will be necessary to evaluate municipal sludge management practices. Regulations proposed by EPA would require the State of Montana to develop an approved sludge management program if the state accepts responsibility for the program.

6.1.2. PRETREATMENT PROGRAM

The goal of the national pretreatment program is to protect municipal wastewater treatment plants and the environment from the adverse impact of hazardous or toxic wastes that are discharged into sewage systems. Although approximately 25 states have developed authorities and regulations to operate pretreatment programs as part of their point source discharge permitting program, the State of Montana does not yet have such authority. Therefore, the Montana EPA Office in Helena has the lead role in working with municipalities and industries throughout the state to minimize adverse impacts from non-domestic waste discharges to sewer systems.

The four main problems that can be prevented through implementation of a local pretreatment program are:

1. Interference with municipal treatment plant operations;
2. Pass-through of pollutants into receiving streams;
3. Municipal sludge contamination, and
4. Exposure of workers to chemical hazards.

Limitation of pollutants into sewage systems is addressed through prohibited discharge standards, categorical pretreatment standards and local limits. Prohibited discharge standards apply to all industrial and commercial users, and prohibit discharge of flammable, explosive, corrosive or other interfering substances. Categorical pretreatment standards apply to industrial and commercial discharges in 25 specific industrial categories determined to be the most significant sources of toxic pollutants. Each city may also establish and enforce local limits necessary to provide the degree of protection needed for its particular situation.

The cities of Billings, Bozeman, Missoula and Great Falls have all developed EPA-approved local pretreatment programs to regulate industrial users of their systems. Two pretreatment programs (Billings and Great Falls) have been funded through the Construction Grants Program. The City of Missoula, through use of its approved pretreatment program, is negotiating with an industrial discharger whose waste is adversely affecting performance of the treatment plant. Two other cities, Butte and Helena, are also in the final stage of developing an approvable program. Each of these communities has conducted industrial inventories and established legal authorities to identify and control potentially harmful discharges. Assistance is provided as needed by EPA and the DHES to other smaller communities in Montana that may be impacted by industrial waste discharges.

6.1.3. PERMITS AND ENFORCEMENT PROGRAM

The Permits and Enforcement Program administers: 1) the Montana Pollutant Discharge Elimination System (MPDES), 2) the Montana Surface Water Quality Standards (MSWQS) and 3) the Montana Groundwater Pollution Control System (MGWPCS).

Under MPDES, all point-source waste discharges to surface waters must be permitted by the DHES Each permit contains limitations and conditions which ensure that state water quality standards and the state's policy of nondegradation will not be violated by the discharge The DHES has 180 days to process an application, which includes public participation and a hearing, if requested The DHES requires and reviews self-monitoring by permittees, conducts laboratory quality assurance inspections, field inspections and monitoring and takes enforcement actions to bring dischargers into compliance with permit conditions. Permits are reevaluated and renewed on a regular basis, not to exceed five years. All information on permits is supplied to the EPA.

Under MSWQS, complaints of water pollution are investigated and resolved; plans for short-term instream construction are reviewed and modified to reduce the effects on water quality, and plans for leach pads, tailings ponds and ponds used in the processing of ore are reviewed to ensure that toxic chemicals will not escape and degrade water quality. MSWQS are also used as a basis for MPDES permit conditions.

The permits program promulgated general discharge permit regulations through the Board of Health in June 1982. Since then, MPDES general permits have been issued for small suction dredges, facultative sewage lagoons, feedlots, fish farms and construction dewatering operations. These permits enable applicants in the listed category to be assigned the appropriate general permit for operation This has saved processing and administrative time. In 1984 and 1985, 110 and 57 authorizations were issued, respectively, under the various general permits. In 1987, both the construction dewatering and suction dredge general permits will need to be renewed.

The DHES Permits Section administers about 340 individual MPDES permits. Around 200 more authorizations are administered under the 5 general MPDES permits. In 1984-1985, 17 major municipal and 6 major industrial permits were issued or modified, along with 52 minor municipal and 72 minor industrial permits. In 1986-87, 9 major municipal and 6 major industrial permits will need to be issued (Table 6-2). Probably more than 100 minor permits will be issued as well Other activities include corresponding with permittees, reviewing approximately 1500 self-monitoring reports a year, following-up on violations, compliance monitoring and quality assurance work with laboratories and inspecting facilities Also the DHES is updating the MPDES regulations and the MPDES delegation agreement

Tracking of MPDES permittee self-monitoring and compliance has been done manually from reports sent in by the permittees. The staff has

Table 6-2. Major permits issued, 1984-1987

Year	Major Industrial	Major Municipal
1984	Champion (now Stone)-Frenchtown	Lewistown
	MDU-Sidney	Hardin
	MPC-Corrette	Dillon
	Anaconda Minerals-Grt. Falls	Laurel
		Conrad
		Whitefish
1985	Holly Sugar	*Butte
	Champion-Libby	*Billings
		*Livingston
		*Bozeman
		*Havre
		*Kalispell
		*Missoula
		*Great Falls
		Columbia Falls
		**Deer Lodge
		Libby
1986	Champion-Frenchtown	Helena
	Decker Coal (West Mine)	Livingston
	Decker Coal (North Mine)	
	Western Sugar	
1987	Champion-Bonner	Billings
	Western Energy	Bozeman
		Great Falls
		Havre
		Kalispell
		Missoula
		Butte

* Modified for oil and grease

** Modified for total suspended solids (national secondary standard for lagoons)

recently decided to try to use the EPA Permit Compliance System (PCS) database and a computer system as an aid in handling the large amount of data generated by the many MPDES permittees. The computer system would allow easier access to permit information and enable staff to use data in various report formats. Compliance schedules, facility data, enforcement records, compliance sampling and inspection data and self-monitoring data could be stored and retrieved.

To accomplish this, the DHES has applied for an additional $32,600 in funding from the EPA to purchase computer hardware and software and hire an individual part-time to enter permittee data into the system and assist in tracking and generating the various reports. With recent funding cutbacks, the fate of the request is in doubt. However, the WQB believes a high priority should be given to this funding because it will enable greater use of the MPDES permittee data. Once the system is in place, better tracking will be possible, resulting in a savings of professional time.

6.1.3.1. PERMIT COMPLIANCE

Special attention has been given to permittees in the Flathead Lake drainage due to eutrophication problems and the 1984 DHES phosphorus strategy. (See related sections 5.1, 6.4.2., 6.5.1. and 6.5.2.) Phosphorus limits have been imposed on all permits, and compliance schedules have been required of those facilities which cannot presently meet the 1.0 mg/l limit on total phosphorus. Compliance is expected by all of the facilities by July 1, 1988.

Additionally, the DHES is taking a close look at the Clark Fork River due to public concern over maintaining water quality. (See Sections 5.2, 6.5.3 and 6.4.1.) One outcome could be nutrient limitations being placed on permittees in the basin to protect against nuisance algae growth in the lower river and Lake Pend Oreille, Idaho. Further studies are needed before final decisions can be made. Several major and minor permits in the basin are coming up for renewal in 1986-87, including the Champion Sawmill in Missoula, The Champion (now Stone) paper mill near Frenchtown, the City of Missoula wastewater treatment plant (WWTP), the John R. Daily meat processing plant, the Champion sawmill at Bonner and WWTPs at Lolo, Butte and Alberton.

A number of permits have been studied for possible ammonia toxicity problems. Ammonia limits have been included in permits for WWTPs at Bozeman, Browning and Whitefish, and are planned for the permits of four coal mines that are, or will be, discharging into the Tongue River. The Missoula and Ronan WWTP permits will be further evaluated for ammonia limits.

The National Policy for Wastewater Treatment Facilities calls for all municipal wastewater treatment facilities to meet national secondary treatment standards by July 1, 1988. All municipalities needing upgrading have been required to have firm compliance schedules since October 1, 1985.

An intensive effort continues to bring all municipal wastewater dischargers into compliance with national secondary treatment requirements and Montana water quality standards by July 1, 1988. There are currently 30 facilities on compliance schedules to meet these goals. The eight major facilities that are, or will be, improving their plants are Laurel, Lewistown, Libby, Havre, Whitefish, Columbia Falls, Dillon, and Kalispell. All are progressing satisfactorily. Twenty-two minor facilities are scheduled to meet applicable standards. These facilities are monitored regularly to insure that progress is being maintained.

6.1.3.2. ENFORCEMENT

Enforcement pursuant to the Montana Water Quality Act (WQA) is taken to accomplish several general goals. These goals include:

1. To eliminate or abate pollution of state water;
2. To encourage corrective actions necessary to prevent the recurrence of a water pollution situation;
3. To modify a situation which has the potential to cause pollution of state waters;
4. To assess and collect civil penalties;
5. To recover DHES enforcement costs.

A variety of enforcement options are provided in the act for accomplishing these goals, and for any given situation, a determination is made based on the options.

The following are summaries of enforcement actions taken during calendar years 1984 and 1985 under the Montana WQA, the Montana Safe Drinking Water Act (SDWA), and the Montana Sanitation in Subdivisions Act (SSA). Formal enforcement actions initiated in 1984 and 1985 under the WQA and SDWA are listed in Tables 6-3 through 6-6.

1984 Summary

123 Citizen Complaints investigated by the Helena office (no data available for Billings office)

16 Violation Report Forms transferred to Legal Division requesting Formal Enforcement Action (9 WQA and 7 SDWA)

5 Administrative Enforcement Orders were issued (5 WQA)

14 Civil Complaints were filed in District Courts, seeking corrective actions, injunctive relief, assessment of civil penalties and recovery of DHES enforcement costs (5 WQA and 9 SDWA)

12 Civil cases were resolved by stipulations requiring corrective actions, payment of cash civil penalty and/or suspended civil penalty, and recovery of DHES enforcement costs (7 WQA and 5 SDWA)

$35,750 in civil penalties were collected (8 cases) under the Water Quality Act

Table 6-3. Formal enforcement actions initiated during 1984 pursuant to the Montana Water Quality Act

Name	Date	Type of Business	Violation	Character of Pollutant	Type of Action
Transbas, Inc. Billings, MT	2-3-84	Pesticide Formulator	U.A.D. P.W.	Pesticide/Herbicide	Civil Comp*
Columbia Falls, City of	5-10-84	Municipality	U.A.D.	Domestic Sewage Sludge	Civil Comp*
Falcon Explor/GRS near Helena, MT	5-25-84	Heap Leach Mill	P.W.	Cyanide Process Waters	A.O.[1]
ASARCO East Helena, MT	4-5-84	Smelter	U.A.D. P.W.	Dissolved Metals	Civil Comp*
ASARCO Troy, MT	6-27-84	Mine/Conc.	U.A.D. P.W.	Mill Tailings	Civil Comp*
USFS, Beaverhead	1-31-84	U.S. Gov't	P.W.	Sediment	A.O.*
Castles Sapphire Mine near Helena, MT	11-84	Placer Mine	U.A.D. P.W.	Suspended Solids	A.O.*
Motherlode Helena, MT	8-30-84	Silver recovery from used film	U.A.D. P.W	Cyanide Process Waters	A.O.[1]
U.S. Antimony Thompson Falls, MT	12-6-84	Mill	P.W	Dissolved Metals	A.O.[1]
Montana Refining Co. Great Falls, MT	12-14-84	Petroleum Refinery	E.L.V P.V.	Oxygen Demand Oil and Grease	Civil Comp*

1 = Pending resolution
* = Settled
A.O. = Any formal administrative order to achieve compliance
Civil Comp = Any formal action initiated through petition of the District Court
C.P. = Causing pollution
E.L.V = Effluent limitation violation
P.V. = Permit violation
P.W. = Placing wastes
U.A.D. = Unauthorized discharge

Table 6-4 Formal enforcement actions initiated during 1985 pursuant to the Montana Water Quality Act

Name	Date	Type of Business	Violation	Character of Pollutant	Type of Action
Motherlode Helena, MT	7-19-85	Silver recovery from used film	P.W. U.A.D.	Cyanide Process Waters	Civil Comp[1]
Belt, MT	2-28-85	Municipality	E L.V.	Domestic Sewage Sludge	A.O.*
Fromberg, MT	1985	Municipality	E.L.V.-C.S.	N/A	A.O.*
MPC-Corette Billings, MT	2-28-85	Power Generation	E.L.V.	Suspended Solids	A.O.*
St. Bernard Restaurant Bridger Bowl, MT	4-8-85	Rec. Facility	U.A.D. P.W.	Domestic Sewage	A.O.*
Kalispell, City of	3-27-85	Municipality	E.L.V.	Suspended Solids	A.O.*
Golden Maple Mining Lewistown, MT	4-16-85	Heap Leach	P.W. U.A.D.	Cyanide Process Waters	Civil Comp*
Golden Maple Mining Lewistown, MT	8-2-85	Heap Leach	P.W. U.A.D.	Cyanide Process Waters	Civil Comp[1]
Schmaus Logging near Helena, MT	5-30-85	Logging	P.W.	Sediment/Debris	Civil Comp*
John-Boy Construction Bozeman, MT	7-1-85	Construction Co. I-15	U.A.D.	Suspended Solids	Civil Comp*
Washington Construction Missoula, MT	7-1-85	Construction Co. I-15	U.A.D. P.W.	Sediment	Civil Comp*
Billings, City of	6-20-85	Municipality	Pre-Treat.	N/A	A.O.*
Bozeman, City of	6-20-85	Municipality	Pre-Treat.	N/A	A.O.*
Triad Investments Lewistown, MT	8-1-85	Heap Leach	P.W. U.A.D.	Cyanide Process Waters	Civil Comp[1]
Helena, City of	9-12-85	Municipality	Pre-Treat.	N/A	A.O.*
Silver Bow Metro Butte, MT	9-12-85	Municipality	Pre-Treat.	N/A	A.O.*
Golden Maple Mining Lewistown, MT	9-26-85	Heap Leach	U.A.D. P.W.	Cyanide Process Waters	A.O.[1]

Table 6-4. (continued)

Name	Date	Type of Business	Violation	Character of Pollutant	Type of Action
Inca Gold Belt, MT	10-2-85	Vat Leach	P.V.	N/A	A.O.[1]
Manger-Cope Tri-Rivers Lumber near Helena, MT	10-4-85	Logging	P.W.	Sediment/Debris	A.O.*
Montex Virginia City, MT	10-9-85	Placer Mining	P.W	Placer Tailings	Civil Comp[1]
Miller Mining Radersburg, MT	11-27-85	Mill	U.A.D. P.W	Mill Tailings	Civil Comp[1]
Viking Mine Elliston, MT	12-19-85	Heap Leach	P.W. U.A.D.	Cyanide Process Waters	A.O.[1]
Montana Mining & Timber Gold Creek, MT	12-6-85	Mill/Placer	U.A.D.	Suspended Solids/ Metals	Civil Comp[1]

1 = Pending resolution
* = Settled
A.O. = Any formal administrative order taken to achieve compliance
Civil Comp = Any formal action initiated through petition of the District Court
C.P. = Causing pollution
C.S. = Compliance schedule
E.L.V. = Effluent limitation violation
P.V. = Permit violation
P.W. = Placing wastes
U.A.D. = Unauthorized discharge

Table 6-5. Formal enforcement actions initiated during 1984 pursuant to the Montana Safe Drinking Water Act

Name	Date	Type of Business	Violation	Type of Action
Spruce Park Tr. Ct. Kalispell, MT	1-11-84	P.W.S. Trailer Court	F.T.M. T.S.S.V.	A.O.*
Springdale Colony White Sulphur Springs, MT	2-3-84	P.W.S.	T.S.S.V F.T.M.	Civil Comp*
Mission Meadows Tr. Ct. near Ronan, MT.	1-31-84	P.W.S.	F.T.M.	Civil Comp*
Hilldale Colony Havre, MT	9-24-84	P.W.S.	F.T.M.	Civil Comp*
E.M. KAYAN Libby, MT	9-28-84	P.W.S.	P. & S.V.	Civil Comp*
Denton, MT	10-1-84	P.W.S. Municipality	Mcl. V.	Civil Comp*
Thiel's Trailer Ct. Havre, MT	5-3-84	P.W.S.	Mcl. V F.T.M.	Civil Comp*

1 = Pending resolution
* = Settled
A.O. = Any formal administrative order taken to achieve compliance
Civil Comp = Any formal action initiated through petition of the District Court
F.T.M. = Failure to monitor
Mcl. V. = Maximum concentration limit violation
N.C.O. = No certified operator
P.& S.V. = Plans and specifications violation
P.W.S. = Public water supply
T.S.S.V. = Ten States Standards violation

Table 6-6 Formal enforcement actions initiated during 1985 pursuant to the Montana Safe Drinking Water Act

Name	Date	Type of Business	Violation	Type of Action
Sunset West Homeowners Missoula, MT	6-4-85	P.W.S.	F.T.M. N.C O.	Civil Comp*
T & C Trailer Ct. Arlee, MT	2-15-85	P.W S.	F.T.M.	Civil Comp*
Johnny's Bar Belt, MT	3-29-85	P.W.S.	F.T.M	Civil Comp*
Schmaus Logging near Helena, MT	5-30-85	Logging	P.W. in water supply	Civil Comp*
Mission Meadows Tr. Ct. Ronan, MT	11-20-85	P.W.S.	Contempt	Civil Comp*
Kootenai Trailer Ct. Libby, MT	10-3-85	P.W.S.	F T.M.	Civil Comp*
Snuff's Place Warren, MT	10-9-85	P.W.S.	F.T.M.	Civil Comp[1]
Woodside Park Conrad Peterson near Thompson Falls, MT	12-18-85	P W.S.	P. & S.V	Civil Comp[1]
D. Johnson Wheatland Condos Billings, MT	12-11-85	P.W.S	P. & S.V.	Civil Comp[1]
A. Althoff Timbers Condos Billings, MT	12-20-85	P.W.S.	P. & S.V	A.O.[1]
Helena, City of	12-5-85	P.W.S. Municipality	Mcl. V.	A.O[1]
Brewer Trailer Courts Forsyth, MT	12-6-85	P.W.S	Multiple	Civil Comp[1]

1 = Pending resolution
* = Settled
A.O. = Any formal administrative order taken to achieve compliance
Civil Comp = Any formal action initiated through petition of the District Court
F T.M. = Failure to monitor
Mcl V. = Maximum concentration limit violation
N C O. = No certified operator
P & S V. = Plans and specifications violation
P.W = Placing wastes
P W.S = Public water supply

$ 8,126 in DHES enforcement costs were recovered in 13 cases ($6,973 73 in 8 WQA cases and $1,152 05 in 5 SDWA cases)

During 1984 four District Court ordered administratorships were operating at the DHES' request, to implement corrective actions with funding required from the defendants and held by the Clerk of Court. At the end of 1984, one administrator, in the Brazill-Giguere case, completed water pollution control activities, and was released from duty. Three other administrators remained active (Sparrow Resources - WQA, S & G Mining - WQA, and Meadow Hills - SDWA). In October of 1984, the WQB cashed a letter of credit for $13,000 to fund the Meadow Hills administratorship. The Sparrow Resources administratorship was funded by "bond monies" posted with the Department of State Lands and the USFS. The other two administratorships were funded by direct contribution from the defendants in the civil case.

1985 Summary

144 Citizen Complaints were investigated by the Helena office (no data for Billings office)

35 Violation Report Forms were transferred to the Legal Division requesting Formal Enforcement Action (22 WQA, 12 SDWA and 1 SSA)

15 Administrative Enforcement Orders were issued (13 WQA, 1 SDWA and 1 SSA)

18 Civil Complaints were filed in District Courts, seeking corrective actions, injunctive relief, assessment of civil penalties and recovery of DHES enforcement costs (10 WQA, 7 SDWA and 1 SSA)

11 Civil cases were resolved by stipulations requiring corrective actions, payment of cash civil penalty and/or assessment of suspended civil penalties, and recovery of DHES enforcement costs (6 WQA and 5 SDWA)

$24,250 in civil penalties were collected (6 cases) under the Water Quality Act (Total collected through 1985 = $247,100)

$16,500 in civil penalties were assessed (WQA), but suspended in 4 cases pending compliance; to be paid all or in part if compliance is not achieved (Total assessed but suspended through 1985 pending performance = $224,500)

$10,000 in civil penalties were assessed through default judgment in one WQA case; payment has not been made to date

$50,750 is the total civil penalties assessed in the above three categories

$4,588 in DHES enforcement costs were recovered in 11 cases: $3,515.57 in 6 WQA cases and $1,072.70 in 5 SDWA cases (Total WQA costs through 1985 = $24,377 and total SDWA costs through 1985 = $3,055)

Three particularly unique enforcement tools were used during this year. They are: 1) privately funded groundwater investigations, 2) court appointed administratorships and 3) suspended civil penalties to guarantee performance and compliance. A more detailed discussion is provided below.

During this period two major groundwater investigations were initiated to determine the extent and source of observed fuel contamination of shallow groundwater. The studies were accomplished by private consultants through funding negotiated by the DHFS as a contribution from insurance carriers involved in the cases.

These studies were in Dillon and Lincoln, and were essentially completed in 1985, although final reports were not yet available at the end of the year

Three court ordered administratorships remained active in 1985 The Sparrow Resources (WQA) tasks were completed, and formal release of the administrator by the court was expected in early 1986. Funds available to the Meadow Hills administrator (SDWA) were essentially depleted through the completion of significant corrective actions. Major corrections are still needed and the DHES is continuing to seek necessary funding from the defendant through the District Court. The S & G Mining administrator (WQA) remains active, after accomplishing substantial corrective actions. It is anticipated that the acquisition of the property and assumption of WQA responsibilities by a new entity in early 1986 will allow the release of the administrator in mid 1986. If not, sufficient funding remains to allow the administrator to complete court mandated corrective actions

In 1985 the DHES began aggressively seeking the assessment of suspended civil penalties in settlements of civil cases, in addition to cash payment of civil penalties. The settlements negotiated in four cases in 1985 provide for suspension of the penalties, pending performance and payment of all or part of the suspended penalties if violations of law occur during specified periods after settlement This is a powerful incentive to "future compliance" after resolution of civil cases, and will be used when practical in future years. This practice was used only twice before, since delegation of enforcement programs took place in 1974.

6.2. NONPOINT SOURCE PROBLEM AREAS AND CONTROL PROGRAMS

6.2.1. PROBLEM AREAS

Nonpoint sources of water pollution degrade a larger number of river and stream miles and more lake acres in Montana than do point sources. Sediments, salinity, dewatering and acid mine drainage are the nonpoint source pollutants of greatest concern. Ground water contamination from accidental spills, leaking underground storage tanks, and from percolation through mine tailings and waste disposal areas are also concerns. (See Section 4.2.)

Erosion of sediments into surface waters is the most pervasive nonpoint source problem. Erosion occurs as a result of intensive grazing and cropping practices, timber harvesting activities, mineral exploration and development, hydromodification and construction activities. Infringement on riparian zones by such activities destabilizes stream banks and aggravates erosion. The excess stream sediments degrade aquatic habitats and reduce channel stability.

Montana's highest quality surface waters are in its forested, mountainous watersheds. Timber harvesting and road building activities are encroaching more upon the steeper, more sensitive headwater areas. Reduced water quality monitoring and watershed program budgets of the USFS create concern that forest development will cause watershed degradation and resulting impacts will go undocumented.

Much of Montana's soil has a naturally high salt content. Irrigation and cropping practices have led to increased salinization of surface waters. The phenomenon of saline seep, caused by the dryland farming practice of summer fallowing, has salinized surface and ground waters.

Several streams and stream segments are periodically dewatered by irrigation withdrawals. Dewatering eliminates aquatic habitat. Many streams are not dewatered completely, but experience stream flow reductions which are severe enough to elevate temperatures and adversely impact aquatic life.

A hundred years of mining and mineral development have left a legacy of streams with toxic metals and acid mine drainage problems. Abandoned mine tailings leach toxic levels of copper, zinc and cadmium to many Montana streams. These metals exert stress on aquatic ecosystems.

In 1985, Montana joined 55 other states, territories and interstate water quality agencies in assembling existing information on water quality impacts caused by nonpoint sources of pollution. The effort was coordinated and the findings compiled and published by the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA).* This assessment provides baseline information which can be used to compare future measurements of nonpoint source impacts. The comparison can help to gauge the effectiveness of nonpoint source control programs.

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* ASIWPCA. 1985. America's Clean Water, The States' Nonpoint Source Assessment, 1985. Association of State and Interstate Water Pollution Control Administrators. Washington, D.C.

The findings for Montana from the ASIWPCA report are presented in Tables 6-7 through 6-10. The following Montana water resources data will lend some perspective to the statistics in these tables:

1. Total stream miles = 20,532 miles (estimated)

2. Stream miles assessed = 19,505 miles*

3. Total acreage of lakes, reservoirs and ponds
   4,018 lakes = 756,450 acres

4. Total acreage of lakes and reservoirs larger than 5,000 acres each
   12 lakes = 520,450 acres

5. Total acreage of wetlands = 2,000,000 acres (estimated)

Streams with uses impaired by nonpoint sources of pollution are listed in Table 6-11 and located on Figure 6-1. Although supporting water quality information was available for a number of these streams, others were included only on the basis of subjective determinations by county conservation districts, Soil Conservation Service, USFS, and other resource management agencies. Field sampling and on-site review of the severity of these problems will be scheduled as resources allow. Streams will be added or deleted from this list as additional data are collected.

Lakes and reservoirs with uses impaired by nonpoint sources of pollution are listed in Table 6-12. Generic nonpoint source issues and local nonpoint source problems of special concern are also discussed in Sections 4 and 5 of this report.

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* This is the number of stream miles in the DFWP stream data base as of April 9, 1986. It is estimated that this figure represents 95 percent of the stream miles in Montana that support fish. The number of miles assessed in 1985, when the ASIWPCA report was prepared, was slightly less (19,168).

Table 6-7. Summary of nonpoint source impacts to surface waters, by intensity. (Streams are measured in miles, lakes, reservoirs and wetlands in acres.)

Water Body Type	Quantity of Assessed Waters	Intensity of Nonpoint Source Impact			
		Severe	Moderate	Threatened	Minor
Streams	19,168	427	6,377	976	11,388
Lakes and Reservoirs (less than 5,000 acres)	236,000	13,250	6,236	33,234	183,280
Lakes and Reservoirs (more than 5,000 acres)	520,450	0	14,359	452,148	53,943
Wetlands	2,000,000	unknown	unknown	unknown	unknown

Table 6-8 Summary of nonpoint source impacts to surface waters, by source categories.

Source Category	Streams (miles)	Lakes and Reservoirs (acres)
Agriculture	5,930	101,200
Forest Practices	355	3,200
Mining	1,320	35
Land Disposal	50	132,890
Hydromodification	20	280,332
Urban Runoff	5	1,570
Construction	90	0
Other	10	0
Totals	7,780	519,227

Table 6-9. Summary of nonpoint source impacts to surface waters, by pollutant.

Pollutants	Streams (miles)	Lakes and Reservoirs (acres)
Sediment/Turbidity	6,275	26,900
Nutrients/Fertilizers	160	185,000
Pesticides	4	0
Toxics (mostly metals)	575	35
Acidity	1	unknown
Pathogens	20	1,400
Salinity	535	22,000
Oxygen Demand	unknown	unknown
*Alteration of Physical Habitat	210	283,892
Totals	7,780	519,227

*Includes impacts from hydrological modification.

Table 6-10 Nonpoint source impacts on surface waters in Montana (Streams are measured in miles, lakes and reservoirs in acres; U = Unknown)

Nonpoint Source Pollutant	Water Bodies Aggregate Size	Intensity of Nonpoint Source Impact			Nonpoint Source Categories							
		Severe	Moderate	Threatened	Agriculture	Forest Practices	Construction	Urban Runoff	Resource Extraction and Residue	Land Disposal	Hydromodification	Other
SEDIMENT/TURBIDITY												
Streams	6600	180	5900	520	4650	450	250	230	480	120	400	20
Lakes and Reservoirs	441865	0	10420	431445	29340	3175	U	U	U	128950	280400	U
NUTRIENTS/FERTILIZER												
Streams	3000	50	2890	60	2000	10	130	230	150	100	380	U
Lakes and Reservoirs	185000	0	2900	182100	10500	U	U	1580	U	132920	40000	U
PESTICIDES												
Streams	40	0	5	35	40	U	0	U	0	U	0	U
Lakes and Reservoirs	U	U	U	U	U	U	U	U	U	U	U	U
TOXICS												
Streams	900	170	700	30	U	0	U	U	890	U	0	10
Lakes and Reservoirs	35	0	0	35	U	U	U	U	35	U	U	U
ACIDITY												
Streams	90	35	55	0	0	0	0	0	90	0	0	0
Lakes and Reservoirs	0	0	0	U	0	0	0	0	0	0	0	0
PATHOGENS												
Streams	190	40	130	20	188	0	0	0	0	2	0	0
Lakes and Reservoirs	4000	0	1400	2600	4000	U	0	U	0	U	0	0
SALINITY												
Streams	2430	145	1855	400	2155	0	0	0	250	0	20	0
Lakes and Reservoirs	22000	0	8750	13250	22000	0	0	U	U	0	U	0
OXYGEN DEMAND												
Streams	U	0	0	U	U	U	0	0	0	0	U	0
Lakes and Reservoirs	1600	0	0	1600	U	U	0	1600	0	U	U	0
PHYSICAL HABITAT ALTERATION												
Streams	1450	6	1420	24	820	190	40	20	320	40	20	0
Lakes and Reservoirs	3570	0	3570	0	3570	U	U	0	0	0	U	0
TEMPERATURE												
Streams	1830	15	1760	55	1250	U	0	0	0	0	575	0
Lakes and Reservoirs	320400	0	0	320400	0	0	0	0	0	0	320400	0
DEWATERING												
Streams	1160	35	1125	U	1160	0	0	0	0	0	0	0
Lakes and Reservoirs	U	U	U	U	U	U	U	U	U	U	U	U

Table 6-11. Streams in Montana with uses impaired by nonpoint sources of pollution.

Stream Name	County	Stream Name	County
Uses Severely Impaired			
Avalanche	Broadwater	Twin Lakes	Deer Lodge
Beaver	Lewis & Clark	Uncle Sam*	Jefferson
Careless*	Golden Valley	Washington	Powell
Carpenter*	Cascade	White's Gulch	Broadwater
Cataract*	Jefferson	Willow*	Deer Lodge
Coffee	Fergus		
Coller Gulch*	Fergus		
Confederate Gulch	Broadwater		
Corbin*	Jefferson		
Cottonwood*	Cascade		
Daisy*	Park		
Dog	Fergus		
Dry Fork Belt*	Cascade		
Dry Wolf	Fergus		
Elk*	Missoula		
Fisher*	Park		
Galena*	Judith Basin		
Godfrey*	Gallatin		
High Ore*	Jefferson		
Hoover	Powell		
Hot Springs*	Sanders		
Indian	Broadwater		
Jefferson	Powell		
Lime	Lincoln		
Little Bitterroot River	Sanders		
Mike Horse*	Lewis & Clark		
Mill	Deer Lodge		
Monarch	Deer Lodge		
Muddy*	Cascade		
Number Five Coulee*	Cascade		
Prickly Pear*	Lewis & Clark		
Sage	Hill		
Sand Coulee*	Cascade		
Silver*	Lewis & Clark		
Silver Bow*	Silver Bow		
Snowshoe*	Lincoln		
Soda Butte*	Park		
South Boulder River*	Madison		
Spring*	Jefferson		
Sun River*			
Trout	Lewis & Clark		

Table 6-11. Continued

Stream Name	County	Stream Name	County
Uses Moderately Impaired			
Armells*	Fergus	Cottonwood	Cascade
Bear	Carbon	Crane	Richland
Bear	Powell	Crow*	Lake
Beaver	Broadwater	Cut Bank	Glacier
Beaver	Fergus	Deep	Broadwater
Beaver	Hill	Deep	Teton
Beaver	Meagher	Dempsey	Powell
Beaver*	Phillips	Dog	Powell
Beaver*	Wibaux	Douglas*	Granite
Beaverhead River*		Douglas	Powell
Belt*	Cascade	Dry	Broadwater
Benton Gulch	Meagher	Dry Cottonwood	Deer Lodge
Big Hole River*		Dry Cottonwood	Powell
Big Pipestone	Jefferson	East Fork Indian	Broadwater
Big Sandy	Hill	East Fork Poplar River*	
Big Spring*	Fergus	East Gallatin River*	
Bighorn River*		Elkhorn	Beaverhead
Birch	Pondera	Elkhorn	Jefferson
Bitterroot River*	Ravalli	Elliston	Powell
Blackfoot River*		First Hay	Richland
Blacktail Deer	Beaverhead	Fish Trap	Sanders
Blodgett	Ravalli	Fisher River*	
Bluewater*	Carbon	Flat	Lewis & Clark
Bonnie Peer	Richland	Flathead River*	
Boulder River*	Jefferson	Flat Willow	Fergus
		Flint*	Granite
Box Elder	Cascade	Fool Hen*	Lewis & Clark
Brock	Powell	Ford	Lewis & Clark
Bull Hook	Hill	Fox	Richland
Butte	Daniels	Frazier	Powell
Cable	Deer Lodge	Gallagher	Powell
Cache	Gallatin	Gallatin River*	
Camas	Sanders	Gold	Powell
Camp*	Gallatin	Grasshopper*	Beaverhead
Canyon*	Yellowstone	Halfway	Powell
Chamberlain	Powell	Hardscrabble	Richland
Cherry	Lincoln	Horse Prairie	Beaverhead
Chicago Gulch*	Fergus	Hound	Cascade
Clancy*	Jefferson	Hyalite*	Gallatin
Clark Canyon	Beaverhead	Idaho	Madison
Clark Fork River*		Jefferson	Powell
		Jefferson River	

Table 6-11. Continued

Stream Name	County	Stream Name	County
Judith River		O'Brien	Richland
Keeler	Lincoln	Otter	Cascade
Kennedy	Missoula	Peterson	Powell
Keyser	Richland	Petty	Missoula
La Velle	Missoula	Poplar River*	
Libby	Lincoln	Post*	Lake
Little Belt	Cascade	Potter	Meagher
Little Bighorn River*		Poorman	Lewis & Clark
Little Blackfoot River*		Prospect	Sanders
Little Box Elder	Hill	Racetrack	Powell
Little Joe	Mineral	Ramshorn	Madison
Little Peoples*	Blaine	Randolph	Mineral
Little Prickly Pear	Lewis & Clark	Rattlesnake	Missoula
Little Rocky	Stillwater	Red Rock River	
Lolo	Missoula	Redwater River*	
Lone Tree	Richland	Roaring Lion	Ravalli
Lost	Deer Lodge	Rock	Powell
Lost Horse	Ravalli	Ross Fork	Fergus
Lump Gulch*	Jefferson	Ruby River	
Lynch	Sanders	Sabine	Lake
Marias River*		Sage	Hill
McCormick	Missoula	St. Regis River	
McDonald	Fergus	Saline	Beaverhead
McElwain	Powell	Schwartz	Missoula
Medicine Lodge	Beaverhead	Sears	Richland
Middle Fork Warm Springs	Jefferson	Sheep	Meagher
Milk River*		Sheep	Powell
Mill	Deer Lodge	Shields River	
Miller	Missoula	Six Mile	Meagher
Mission*	Lake	Sixteenmile	Meagher
Missouri River*		Sleeping Child	Ravalli
Modesty	Deer Lodge	Smith	Richland
Monarch	Deer Lodge	Smith River	
Montana Gulch*	Phillips	Snowshoe	Powell
Monture	Powell	Soap	Big Horn
Mud	Lake	Spotted Dog	Powell
Muddy	Beaverhead	Spring*	Lake
Musselshell River*		Stillwater River*	Flathead
Nevada	Powell	Stillwater River	Stillwater
Newlan	Meagher	Sullivan	Sanders
Ninemile	Missoula	Taylor Fork	Gallatin
North Fork Muddy	Teton	Telegraph	Powell
O'Brien	Missoula	Tenmile*	Lewis & Clark

Table 6-11 Continued

Stream Name	County
Thompson Gulch	Meagher
Thompson River	
Threemile	Powell
Threemile	Ravalli
Tin Cup Joe	Powell
Tobacco River	
Trapper	Beaverhead
Trout	Sanders
Two Medicine River*	
Valley	Stillwater
Virginia*	Lewis & Clark
Wales	Powell
Ward	Powell
Warm Spring	Fergus
Warm Springs*	Deer Lodge
Warm Springs	Powell
Warren	Powell
West Miller Coulee	Lake
West Rosebud	Stillwater
Whitefish River*	
Willow*	Deer Lodge
Willow	Teton
Wilson	Jefferson
Wolf	Lincoln
Yellowstone River*	
Yourname	Powell

* Stream has recent (post-1975) data in STORET indicating that one or more beneficial uses are impaired (See Table 3-2 and Appendix.)

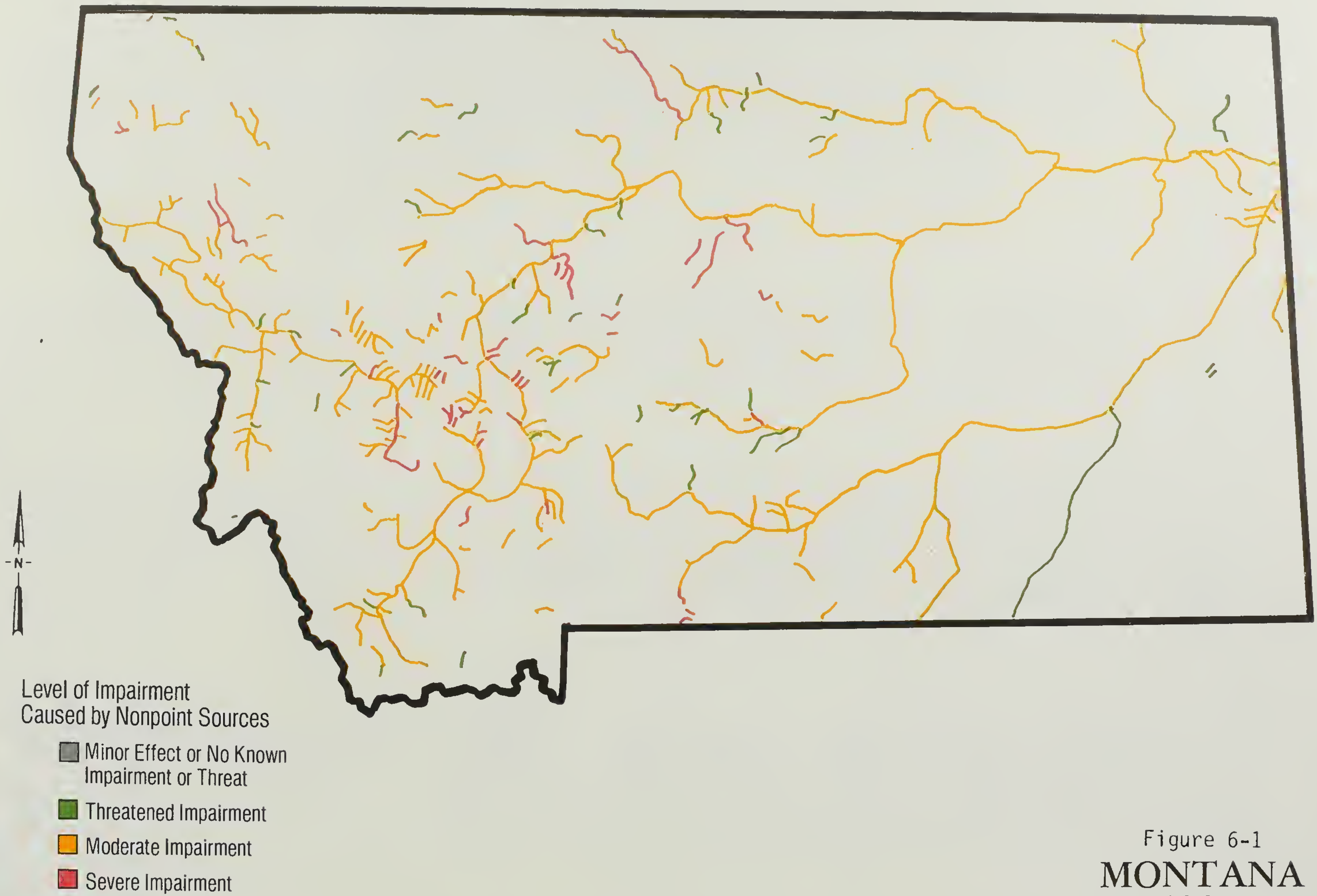

Figure 6-1

MONTANA

1985

Nonpoint Source Surface Water
Designated Use Impairments.

Table 6-12. Lakes and reservoirs in Montana with uses impaired by nonpoint sources of pollution.

<u>Uses Severely Impaired (13,250 acres)</u>
Benton Lake (Cascade County)
Freezeout Lake (Teton County)
Lake Bowdoin (Phillips County)
Priest Butte Lakes (Teton County)
<u>Uses Moderately Impaired (20,595 acres)</u>
Duck Lake (Glacier County)
Echo Lake (Flathead County)
Fresno Reservoir (Hill County)
Hailstone Lake (Stillwater County)
Lake Francis (Pondera County)
Lake Helena (Lewis and Clark County)
Lebo Lake (Wheatland County)
Medicine Lake (Sheridan County)

6.2.2. CONTROL PROGRAMS

There are many different programs, administered by a variety of agencies, that address nonpoint source pollution problems in Montana (Table 6-13). The DHES administers the water quality management program in the state. The department, in its Statewide 208 Water Quality Management Plan, has established a voluntary nonpoint source control program. County conservation districts are designated the nonpoint source management agencies for non-federal land.

The program is intended to encourage adoption and implementation of best management practices (BMPs) Technical assistance, education, demonstration projects, and financial assistance are used to implement BMPs.

The DHES maintains cooperative agreements with 57 conservation districts and the Conservation Districts Division of the Department of Natural Resources and Conservation (CDD-DNRC).

The DHES also has cooperative agreements with the Bureau of Land Management (BLM) and the USFS, which are designated the nonpoint source management agencies for lands under their jurisdiction. The U.S. Department of Agriculture (USDA) cost-share programs offer financial incentives for implementation of best management practices on agricultural lands in Montana.

The Renewable Resource Development and Water Development programs and the 223 Program, all administered by the DNRC, provide funding to water quality management projects. The Montana Stream Protection Act and Natural Land and Streambed Preservation Act are state and locally administered programs that, along with the Corps of Engineers 404 Dredge and Fill Permit Program, control nonpoint source pollution for hydromodification activities The Montana Salinity Control Association, a consortium of conservation districts in dryland farming areas, provides educational and technical assistance to implement agricultural management practices to control saline seep. The Abandoned Mine Land (AML) reclamation program, administered by the DSL, is aimed at the reclamation of abandoned coal mine areas, and provides for reclamation of abandoned hardrock mine areas where public health and safety are at risk. The Superfund program administered by EPA and the DHES offers the potential for addressing nonpoint pollution problems related to toxic and hazardous waste sites, including some abandoned mine waste problems.

The DHES conducts water quality monitoring, assesses and prioritizes nonpoint and point source problems, and provides management of the programs. A priority list is kept of stream segments and lakes that have assessed, man-caused water quality problems (See Section 3.5.) The list is used to focus limited management resources on the highest priority problems.

Table 6-13 Summary of nonpoint source control programs in Montana

Program	Administering Agencies: Local	Administering Agencies: State	Administering Agencies: Federal	Program: Type	Program: Extent	Nonpoint Source Activities	Effectiveness of Water Quality Protection
State Water Quality Management Program (Section 205j, Clean Water Act)	Conservation Districts	WQB-DHES CDD-DNRC	BLM FS EPA	Voluntary	Statewide	Agriculture Forest Practices Construction Resource Extraction and Residue	Locally/ Partially
Agricultural Conservation Program			ASCS	Incentive	Statewide	Agriculture	Partially
Great Plains Conservation Program			SCS	Incentive	Regional	Agriculture	Partially
Bureau of Land Management's land management responsibilities			BLM	Regulatory	Statewide	Agriculture Construction Forest Practices Resource Extraction and Residue	Partially
US Forest Service's forest land management responsibilities			FS	Regulatory	Statewide	Forest Practices Resource Extraction and Residue	Partially
Bureau of Reclamation activities			BR	Other	Statewide	Hydro-modification	Partially
Cooperative Extension Service activities			ES	Voluntary	Statewide	Agriculture Forest Practices	Partially
Pesticide Application Licensing Program		DOA	EPA	Regulatory	Statewide	Agriculture	Partially
Abandoned Mine Land Reclamation Fund		DSL	OSM	Regulatory	Statewide	Resource Extraction and Residue	Locally/ Partially
US Fish & Wildlife Service programs			FWS	Other	Local	Habitat Management	Locally/ Partially
State Certification pursuant to Section 401 of the Clean Water Act		WQB-DHES	COE	Regulatory	Statewide	Hydromodif-ication	Locally/ Partially
			FS	"	"	Forest Practices	"
Federal Certification pursuant to section 401 of the Clean Water Act			EPA	Regulatory	Statewide (on Indian Reservations)	All	Locally/ Partially
Renewable Resource Development Funds and Water Development Program Funds		WRD-DNRC		Incentive	Statewide	Agriculture Forest Practices Resource Extractinn and Residue	Locally/ Partially
223 Progam for funding conservation projects through Conservation Districts	Conservation Districts	CDD-DNRC		Incentive	Statewide	Agriculture Forest Practices	Locally/ Partially
Montana Salinity Control Assnciation	Conservation Districts	CDD-DNRC		Voluntary	Regional	Agriculture	Locally/ Partially

Table 6-13. Continued

Program	Administering Agencies: Local	State	Federal	Program: Type	Extent	Nonpoint Source Activities	Effectiveness of Water Quality Protection
Stream Protection Act Permits		DFWP		Regulatory	Statewide	Hydro-modification	Locally/ Partially
Natural Streambed and Land Preservation Act Permits (310)	Conservation Districts	CDD-DNRC DFWP		Regulatory	Statewide	Hydro-modification	Locally/ Partially
Sanitation in Subdivisions	Health Departments	WQB-DHES		Regulatory	Statewide	Subdivision Wastewater Disposal	Locally/ Partially
Cooperative Forest Management		DSL		Voluntary	Regional	Forest Practices on Watersheds with Inter-mingled Ownership	Locally/ Partially
Watershed Protection and Flood Prevention Program (PL 566)			SCS	Incentive	Statewide		Ineffective or Partially
Hazardous & Solid Waste Management Programs & Superfund		SHWB-DHES	EPA	Regulatory	Statewide	Resource Extraction Land Disposal Storage Tanks Hazardous Waste Storage	Locally/ Partially
Office of Surface Mining active mining regulatory responsibilities		DSL	OSM	Regulatory	Statewide	Resource Extraction and Residue	Locally/ Partially
Sediment Control Ordinance	Lewis & Clark Conservation District			Regulatory	Local	All	Partially
Soil Conservation ("sodbusting") Ordinance	Petroleum Conservation District			Regulatory	Local	Agriculture	New
Conservation Reserve Program			ES SCS ASCS	Voluntary	Statewide	Agriculture	New
Underground Injection Control			EPA	Regulatory	Statewide	Resource Extraction and Residue; Petroleum Production	New

State Agencies
- WQB-DHES = Water Quality Bureau, Department of Health and Environmental Sciences
- CDD-DNRC = Conservation Districts Division, Department of Natural Resources and Conservation
- DOA = Department of Agriculture
- DSL = Department of State Lands
- WRD-DNRC = Water Resources Division, Department of Natural Resources and Conservation
- DFWP = Department of Fish, Wildlife and Parks
- SHWB-DHES = Solid and Hazardous Waste Bureau, Department of Health and Environmental Sciences

Federal Agencies
- BLM = Bureau of Land Management
- FS = Forest Service, U.S. Department of Agriculture (USDA)
- EPA = Environmental Protection Agency
- ASCS = Agricultural Stabilization and Conservation Service, USDA
- SCS = Soil Conservation Service, USDA

Table 6-13 Continued

BR	= Bureau of Reclamation, U.S. Department of Interior
ES	= Extension Service, USDA
OSM	= Office of Surface Mining
FWS	= Fish and Wildlife Service, Department of Interior
COE	= Corps of Engineers, U.S. Army

Local, state and federal agencies are working to correct and prevent nonpoint source problems in Montana, but much needs to be done. Solutions are difficult to develop and expensive to implement. Additional funding and technical assistance are needed to effectively address priority nonpoint source problems.

The following sections describe recent efforts to control nonpoint source pollution stemming from agriculture, forest practices, mining and highway construction.

6.2.2.1. AGRICULTURE

Montana's nonpoint source water pollution program is voluntary. Due to the poor economic condition of the agricultural sector over the past couple years, county soil and water conservation districts (CDs) in the state have been reluctant to initiate any sizeable or high-cost projects.

Current cost-share programs designed to address nonpoint source pollution are adequate, but in most cases, ranchers and farmers are unable to come up with the matching funds. State programs that offer 100% grants, such as the Renewable Resource Development (RRD) Program, and "223" funds from the Resource Advisory Council, are the main sources of implementation funding for district projects. Each year these funds are becoming more difficult to secure due to the increasing interest in these programs and competition for funds

The DHES is involved in several projects that address pollution from nonpoint sources:

<u>Otter Creek</u>

Otter Creek is a relatively small stream that flows into the Yellowstone River east of Big Timber, Montana.

Stream channel and bank alterations are causing accelerated erosion and increased sediment in the creek. The Sweet Grass Conservation District requested and received a small grant from the DHES to obtain a series of low altitude aerial photographs of Otter Creek for the purpose of performing a streambank inventory. The objective is to identify and map the location of man-caused pollution problems along the creek Breached irrigation ditches, improperly designed irrigation return flows and the inter-basin transfer of water from adjoining watersheds have upset the natural channel configuration of Otter Creek.

The DHES, Soil Conservation Service and Sweet Grass Conservation District are scheduling a series of meetings with the local land occupants for the purpose of establishing a joint control project. If the landowners agree, a grant request will be drafted and presented to the Department of Natural Resources and Conservation for ranking and possible funding through the RRD Program.

Muddy Creek

Muddy Creek, a tributary of the Sun River west of Great Falls, still ranks as one of the most serious water quality problems in the state (See Section 5.9.) The Muddy Creek Task Force and the Small Watershed Project sponsored by the Soil Conservation Service are continuing their efforts to minimize irrigation return flows to reduce sediment problems in Muddy Creek.

To understand some of the other problems associated with Muddy Creek, a streambank inventory was performed by the local conservation districts and the DHES. Results of the inventory have been compiled and a final report prepared. The department will continue to work with the CDs and landowners to establish a riparian improvement program for Muddy Creek.

Musselshell River

The Musselshell River, a tributary of the Missouri River, flows through central Montana. Sediment from stream bank alterations, instability from channel changes, and meander loop cutoffs created by railroad and highway construction are the predominant problems.

A cooperative streambank inventory was performed on 70 miles of the upper Musselshell River by the Upper Musselshell Conservation District, Soil Conservation Service and the DHES. (An inventory was done on the middle reach of the river in 1979.) The inventory will help in assessing potential problems associated with abandonment of the grade of the Burlington Northern Railroad. It is anticipated that the Musselshell River will receive an increase in sediment due to a lack of maintenance of the right of way. To help the landowners along the Musselshell River understand how a stream functions, a stream dynamics workshop was sponsored by the conservation district and the DHES.

Prickly Pear Creek

Prickly Pear Creek, which flows through East Helena, has been targeted as a high priority stream. (See Sections 3.5 and 5.8.) The Lewis and Clark and Jefferson Conservation Districts, Soil Conservation Service and the DHES have been finalizing construction techniques and site specific recommendations for water quality enhancement. For most of the high priority problem sites, corrective measures will be done during the 1986 construction season. A $100,000 RRD program grant has been issued to the CDs for water quality improvements, and will be used for actual construction activities on Prickly Pear Creek.

Conservation districts in the state have begun to realize the value of the streambank physical features inventories. Besides being used as a record of present conditions, the low altitude photography and inventory data help the districts to administer the Natural Streambed and Land Preservation Act. Soil Conservation Service offices use the information to assist cooperators in addressing nonpoint source pollution problems along streams.

For the 1986 field season, requests for financial and manpower assistance to perform streambank inventories have been made to the DHES

by the following conservation districts: Lower Musselshell (lower reach of the Musselshell River), Meagher (Cottonwood Creek and North Fork of the Musselshell River), Gallatin (East Gallatin River and portions of Rocky Creek, Bozeman Creek and Bridger Creek) and Lewis and Clark, Teton, and Cascade (Sun River and portions of Elk Creek)

6.2.2.2. MINING

Many of Montana's nonpoint source water quality problems emanate from past mining activities. Erosion of old mine tailings and discharges from abandoned mine adits are polluting streams. Heavy metals, sediment, dissolved solids, sulfates and acid waters are of greatest concern.

Abandoned hardrock and coal mining operations have caused severe water quality problems in many locations. Recent remedial projects on Silver Bow Creek, the Clark Fork River near Missoula and on Sand Coulee Creek near Great Falls have been undertaken by the DHES, under a Superfund (CERCLA) agreement with the EPA, and by the DSL, respectively Other DSL Abandoned Mine Lands (AML) reclamation projects are located near Jefferson City in Jefferson County and near Butte in Silver Bow County.

Several new mines are expected to have an impact on perennial streams. Accelerated erosion stimulated by road construction, overburden stripping and waste rock stockpiling has the potential to add significant amounts of sediment to steams. Measures to control sediment include leaving vegetative buffer strips, constructing debris barriers and requiring settling ponds.

New precious metals mines, including Golden Sunlight, Jardine Joint Venture, Montana Tunnels Project and the Stillwater PGM Resources Project have included nonpoint source pollution control measures in their operation plans. However, new hardrock mines have not been entirely free from nonpoint source sediment and metals pollution problems. (See Section 6.4.6.)

Placer mines have been consistent contributors of sediment to perennial streams. Mismanagement, improper location of settling ponds and disposal of slimes are the most prevalent problems. Measures that are needed to reduce the impacts of placer and other errant mining operations include larger reclamation bonds, more consistent water quality enforcement actions and more inspections

Historical mining sites may be reclaimed by the DSL-AML program only after all of the state's abandoned coal mine lands have been reclaimed or where public health and safety are at risk. Priorities and projects are defined by the Abandoned Mine Bureau of DSL. New projects or reactivated abandoned mines are permitted by DHES or the DSL Hardrock Bureau. Operational water quality monitoring and nonpoint source pollution control measures are routinely incorporated into the mine permits.

Federal agencies, primarily the U.S Forest Service (USFS) and the Bureau of Land Management (BLM) have been cooperating with the DHES and DSL in trying to assess adequate reclamation bonds and educate miners on sediment impacts and erosion control methods. The USFS has begun to help the DHES implement Section 401 of the Clean Water Act on some National Forests Section 401 requires that any applicant for a federal license or permit to discharge into state waters, first obtain certification from the state that the discharge complies with applicable effluent limitations, water quality standards and any other appropriate requirements ot state law. Proposed activities which cannot be certified by the state, may not be allowed by the federal agency. Interpretations of the 1872 Mining Act and the federal Clean Water Act, and environmental policies of the two agencies, often conflict. This has resulted in the appearance that the USFS is unwilling to embrace all pollution control activities contemplated by federal law

6.2.2.3. FOREST PRACTICES

Most of Montana's high quality water originates from snowmelt in mountainous headwater watersheds. Forest resource development is encroaching on these headwaters areas. Watershed and fisheries values must be preserved in the face of logging, mining, grazing and recreational development.

Montana, through the State Forester, DSL, has taken the lead nationally in addressing the cumulative impacts on watersheds with intermingled ownership. (See Section 5.11.) Major forest landowners, including the USFS, Bureau of Land Management (BLM), Bureau of Indian Affairs, Plum Creek Timber Company, Champion Timberlands and DSL have agreed to participate in this continuing program.

Participants have adopted the following issue statement: "Land management activities can alter the runoff characteristics of a watershed which can affect water quality " The purpose of the program is to allow major forest landowners to exchange information on proposed management activities, and to promote consistent interpretation and implementation of "Best Management Practices" (BMP) to minimize cumulative watershed impacts.

The Montana Water Quality Act states that it is not necessary to treat wastes to a condition that is purer than the natural condition of receiving streams and defines "natural" as "runoff or percolation from developed land where all reasonable land, soil and water conservation practices have been applied (75-5-306 MCA). Hence, BMP are used to control nonpoint source pollution in Montana Yet there is considerable debate over which BMP and how much development in a given watershed are "reasonable "

Consistency in implementation of watershed management practices has been a concern in western Montana As a result of the State Forester's Cumulative Impacts Program and the USFS planning process, the need to revise and update forest BMP was recognized Both the USFS* and the

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* U S. Forest Service, February 1986 Draft Soil and Water Conservation Practices. Forest Service Handbook 2509 22.

State Forester have issued draft revised BMP. Comments were prepared and submitted by private parties, the forest industry, and state and federal agencies in 1985. The USFS and DSL hope to adopt the new BMP in 1986.

With the USFS long-range planning program nearing completion, the 10 national forests in Montana have proposed management direction for the next 10 to 15 years. Management practices, resource production goals and land capabilities have been identified. Goals, objectives, standards, schedules and monitoring requirements comprise each national forest's management plan. The multiple use concept for resource and commodity management has been analyzed in detail by the USFS. The public, industry, state agencies and other federal agencies have had the opportunity to review and comment on draft forest plans. This approach provided valuable information to the USFS in its efforts to produce an acceptable direction for multiple use management.

Development on forested watersheds continues at an accelerated pace. Deterioration of watersheds by nonpoint source pollution is often slow and imperceptible. Natural recovery of damaged watersheds occurs slowly. Several forests in the region have apparently reached, or are quickly approaching, threshold levels for timber production. In these forests, other forest uses may be irreversibly impaired without more intensive management, especially in sensitive areas.

Budget cutbacks have affected many forest management programs, including water quality monitoring. A high priority should be given to monitoring to assess and document impacts from various land uses and the effectiveness of management practices, especially in sensitive areas.

The relationship between water quality deterioration and impaired beneficial uses needs to be established. Sediment thresholds, a recurring question in forest streams, may be more clearly understood if parameters such as turbidity, suspended sediment, cobble embeddedness and percent of fine material in the substrate are linked to trout survival. This tie of pollution (sediment) data to a known beneficial use (fishery) may clarify management options for forest managers by identifying limits. The DHES encourages cooperation between fisheries biologists, watershed managers, engineering staffs and foresters to protect water quality and fishery values.

Several municipalities obtain water supplies from watersheds that are managed for timber production. Special management practices must be implemented in these watersheds. Domestic water supplies (those water systems not meeting community or non-community criteria) and other beneficial uses may require protection from a number of activities that occur in watersheds.

A memorandum of understanding between the USFS and DHES designates the USFS as the nonpoint source management agency for national forest

lands This agreement is being redrafted to address new issues identified by both agencies. One such issue concerns state responsibilities for issuing mining-related permits on federal land Discussions are taking place between the DHES, DSL and USFS to resolve this issue.

6.2.2.4. HIGHWAY CONSTRUCTION

Steep gradient streams are easily destabilized, especially when construction activities have altered the original channel configuration Highway corridors are frequently located in narrow valleys adjacent to streams. In these locations, highways often encroach on stream corridors and floodplains. This encroachment may damage stream habitat and water quality.

The Stream Protection Act, administered by the DFWP, is intended to preserve streams in their natural state The act subjects highway construction projects to review by the DFWP with the intent of reducing impacts on water quality and fish and wildlife habitat. Highway projects in Montana are subject to other regulations, which address construction dewatering, short term exclusions from turbidity standards, dredging and filling and leasing of state-owned, navigable river beds.

Violations of these laws by construction activities over the past year or so initiated an effort in 1985 to evaluate and assess the water quality and aquatic habitat impacts from highway projects.

The efforts evolved out of an attempt to support and follow-up on the Federal Highway Administration's Nonpoint Source Strategy However, it expanded to consider a broader arena of highway construction and environmental conflicts.

Interagency inspections and evaluations of highway construction projects have been done. A workshop was held early in 1986 to explain and discuss regulatory requirements, and to identify construction management practices and procedures. Benefits from this effort will be a greater awareness of pollution potential during construction and a better understanding of water quality regulations that address highway construction.

Wetland destruction from highway construction was another key issue at the workshop. An interagency wetland evaluation committee may be formed to provide improved mitigation of wetland impacts from highway construction.

6.3. GROUND WATER PROTECTION PROGRAM

The Montana Ground Water Pollution Control System (MGWPCS), approved by the BHES in October 1982, includes ground water quality standards, a classification system, a permitting program for potential sources of pollution, and a nondegradation policy MGWPCS requires the DHES to review certain activities which could pollute ground water Activities covered by other permit programs (such as mines under DSL operating permits) are reviewed cooperatively with the DHES to ensure

compliance with standards. The DHES has signed a memorandum of understanding with the DSL to formalize this process.

MGWPCS Activities

During 1984-85, the permits staff issued 14 ground water pollution control permits. Eleven of these were for ore processing operations, while the other three were for waste holding ponds at other industrial sites. In the same time period, the staff also reviewed, for ground water quality standards compliance, about 15 other operations which were permitted by other agencies. Most of these were reviews of mining project operating permit applications to the DSl

The largest amount of time and effort spent in a single segment of the MGWPCS program during 1984-85 was the investigation and follow-up of unanticipated spills and leaks from tanks, ruptured pipelines, transportation accidents and fires Approximately 40 such incidents involving ground water pollution were investigated during 1984-85. Ten of these sites have resulted in more extensive ground water investigations.

Other activities included the review of permittee self-monitoring information, compliance and site evaluation inspections, complaint follow-up and dissemination of program information to interested states, agencies and individuals.

Resource Needs

The MGWPCS program is requesting that an additional full-time employee begin work in July 1986 to assist in field investigations of complaints and perform some of the required site compliance and evaluation inspections. Previously a request had been made for an additional full-time employee, starting in July 1987, to assist in investigations of leaking underground storage tanks.

It is difficult to track and fully utilize the large amounts of ground water quality data that are received under the various monitoring activities. The department hopes to acquire sufficient computer capabilities to allow storage and manipulation of the data from permits, enforcement clean-up cases and other agency projects.

6.4. SURFACE WATER MONITORING PROGRAMS

Monitoring provides basic information for a number of water quality management functions. Among them are the setting of stream classifications, establishing and enforcing water quality standards, evaluating impairment of beneficial uses, detecting trends, determining wastewater treatment requirements, allocating waste loads, arranging problems in order of priority for cleanup action, and assessing the water quality improvements realized from cleanup action.

This section describes ambient (instream or inlake) monitoring conducted or supported by the Department of Health and Environmental Sciences (DHES). The DHES also conducts or oversees several other

types of monitoring which are not discussed here. These include 1) ground water monitoring (Section 4 3.), 2) monitoring in response to complaints (Section 6.1.3), 3) monitoring to check compliance with limits set for permitted discharges (Section 6.1 3.), 4) monitoring of public water supplies (Section 5.3 3), and 5) self-monitoring of municipal and industrial effluents (Section 6 1 3.). Many private entities and other public agencies at all levels of government also perform ambient water quality monitoring in Montana.

The DHES surface water monitoring programs continue to focus on priority waterbodies and priority basins. (See Section 3.5.) Short-term, intensive and synoptic surveys are emphasized rather than long-term, fixed-station and fixed-frequency monitoring. The DHES conducts the latter type of monitoring only on the Clark Fork River (Section 6.4.1.) and only one of these stations -- the Clark Fork at Deer Lodge -- has sufficient period of record for trend assessment. (The U.S. Geological Survey (USGS) maintains 23 long-term monitoring stations in Montana, data from which are suitable for trend assessments. (See Section 3.2.) A total of 3,016 Montana stream miles is assessed by regular and repeated sampling by DHES and USGS for chemical and biological information. This is about 15 percent of the total number of stream miles in the state that have been assessed for biological and (or) chemical water quality parameters (19,505 miles)

Biological sampling (for periphyton and macroinvertebrates) by DHES has been included in monitoring programs on the Clark Fork River, on Ashley, Stanley and Lake creeks, and in four "before-and-after" studies of streams receiving wastewater from upgraded sewage treatment plants. (See corresponding sections that follow.) Sampling at stations on the DHES biological monitoring "Loops", begun in 1977, was discontinued in 1980. The Anaconda Minerals Company and the Institute of Paper Chemistry sample macroinvertebrates annually at stations on Silver Bow Creek and the upper Clark Fork River and on the Clark Fork River near Missoula, respectively. The American Smelting and Refining Company (ASARCO) samples macroinvertebrates three times per year at two stations on Stanley Creek and three stations on Lake Creek near Troy in northwest Montana. (See Section 6.4.6.)

The DHES now has the capability to perform chronic, life-cycle bioassays using the crustacean Ceriodaphnia, also known as the "water flea." Such toxicity testing was performed in 1985 on water from the ASARCO/Troy Project tailings pond and on water from the Clark Fork River released from Milltown Dam during an operational drawdown. (See Sections 6.4.1. and 6.4.6.) The department has ordered a portable incubator, which will allow such bioassays to be conducted in the field.

Quality assurance and data management are two critical support programs for DHES water quality monitoring. All water quality monitoring performed by the DHES conforms to U.S. Environmental Protection Agency (EPA) quality assurance guidelines, and all data so generated are incorporated into the Water Quality Bureau's data management system and entered periodically into EPA's STORET. As resources allow, DHES personnel are working to develop a computerized

data storage and retrieval system for biological data to interface with the existing system for chemical and physical data.

The following sections describe fixed-station monitoring and major intensive surveys conducted by the DHES during 1984 and 1985. Except for the heavy metals survey, all of these programs will continue in 1986 and beyond as resources permit. The DHES has also performed a number of smaller intensive surveys over the past two years (e.g., Mike Horse Creek, Bridger Creek, Stoner Creek) as well as toxic algae reconnaissance on Canyon Ferry and Hebgen Reservoirs. Additional intensive surveys are planned in 1986 or 1987 for the Yellowstone River through Billings and Rock Creek near Red Lodge, resources permitting.

6.4.1. CLARK FORK RIVER

Upper Clark Fork River

Before the turn of the century and into the early 1970's, the upper Clark Fork River was polluted by mining, mineral processing and municipal wastes from the Butte/Anaconda area via Silver Bow Creek. Improvements in wastewater treatment, along with the recent decline of the mining industry in the Butte/Anaconda area, resulted in the reduction of pollution impacts to Silver Bow Creek. However, critically high levels of toxic metals and sediment from extensive mill tailings in the floodplain near Butte perpetuate the creek's tarnished reputation as one of Montana's most polluted streams.

Water quality in the upper Clark Fork has improved markedly during the last decade due to pollution abatement programs, although it still fails to meet criteria designed to protect public health, fish and aquatic life and other beneficial uses. Of primary importance to pollution control efforts are the Warm Springs Treatment Ponds, which remove appreciable amounts of metals and sediment from lower Silver Bow Creek. Continued operation of the ponds since the Anaconda Minerals Company (AMC) suspended operations in 1983 has generally maintained the improved health of the upper Clark Fork, which supports a respectable brown trout fishery. However, high streamflows occasionally bypass the pond system and can cause acutely toxic metals levels, which in turn can result in fish kills.

Water quality below the treatment ponds is also impaired by numerous deposits of mill tailings in the Clark Fork floodplain. Accumulated over many years of indiscriminate waste disposal, they are a source of chronic metals and sediment pollution that will be difficult to abate. (See also Section 5.2.)

The DHES has expanded the monitoring of Silver Bow Creek and the upper Clark Fork to meet requirements for more data. The department currently is collecting water quality data at ten stations between Butte and Garrison (Figure 6-2). The collection of these data are synchronized with the collection of data on the lower Clark Fork River.

The Clark Fork station at Deer Lodge is the principal long-term ambient water quality station on the river. (See Section 3.2. for an

Figure 6-2

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DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
WATER QUALITY BUREAU

CLARK FORK BASIN STUDY SAMPLING LOCATIONS

Site Names for Clark Fork Basin Study Map

01 Silver Bow Creek (SBC) below Colorado Tailings
02 SBC at Miles Crossing near Ramsay
03 SBC above Warm Springs (ACM) treatment ponds
04 ACM Pond #2 discharge (Silver Bow Creek)
05 Mill-Willow Creek bypass at mouth
06 Warm Springs Creek at mouth
07 Clark Fork (CFR) below Warm Springs Creek
08 CFR near Dempsey
09 CFR at Deer Lodge
10 CFR above Little Blackfoot River
11 CFR at Gold Creek Bridge
12 CFR at Bonita
13 CFR at Turah
14 Blackfoot River near mouth
15 CFR below Milltown Dam
16 CFR above Missoula Wastewater Treatment Plant
17 Missoula WWTP discharge
18 CFR at Shuffield's
19 Bitterroot River near mouth
20 CFR at Harper Bridge
21 Stone Container Corporation discharge 003
22 CFR at Huson
23 CFR near Alberton
24 CFR at Superior
25 CFR above Flathead River
26 Flathead River near mouth
27 CFR above Thompson Falls Reservoir
28 CFR below Thompson Falls Dam
29 CFR below Noxon Rapids Dam
30 CFR below Cabinet Gorge Dam

assessment of trends at this station) Comprehensive samples were collected sporadically from 1974 to 1977 and monthly since 1978 Parameters include discharge, field pH and temperature, total suspended solids, turbidity, hardness, specific conductance, lab pH and alkalinity, algal nutrients, common ions and selected metals (arsenic, cadmium, copper, iron, manganese, lead and zinc -- all total recoverable). In September 1985, kjeldahl nitrogen and volatile suspended solids were added and laboratory pH dropped.

Since December 1982 the following five stations have been sampled monthly: Clark Fork River above the Little Blackfoot River, Clark Fork River below Warm Springs Creek, Anaconda Company Warm Springs Pond No. 2 discharge, Mill-Willow Creeks Bypass at mouth and Warm Springs Creek at mouth. Parameters through August 1985 include discharge, turbidity, field pH and temperature, specific conductance, sulfate and selected metals (cadmium, copper and zinc -- all total recoverable).

Silver Bow Creek along the frontage road above the AMC Warm Springs Ponds was added to the monthly sampling in January 1984.

In September 1985, the upper Clark Fork monitoring and an extensive DHES investigation of the lower river were combined to form the Clark Fork Basin Study Three new sampling locations were added to the seven existing stations above the mouth of the Little Blackfoot River: Silver Bow Creek below the Colorado Tailings, Silver Bow Creek near Ramsay and Clark Fork River near Dempsey. The new stations on Silver Bow Creek are downstream from major sources of sediment and metals pollution. The new Clark Fork station is roughly mid-way between the Warm Springs and Deer Lodge stations, and should help to understand the general decline of the water quality and biological health proceeding down river from the Warm Springs Ponds.

To unite the upper and lower monitoring sections, two stations were added on the Clark Fork between the Little Blackfoot River and Turah. These were: Clark Fork at Gold Creek and Clark Fork at Bonita. This reach of river is the least known from the standpoint of water quality, and is the poorest trout fishery in the upper Clark Fork

The list of chemical and physical parameters sampled at each of the Silver Bow Creek and upper Clark Fork stations has been expanded to be more comprehensive and consistent with the lower river monitoring. Parameters sampled since September 1985 include: discharge, field temperature and pH, turbidity, hardness, alkalinity, algal nutrients (nitrate + nitrite, total ammonia, kjeldahl nitrogen, ortho-phosphate and total phosphorous), total and volatile suspended solids and total recoverable arsenic, cadmium, copper and zinc Monitoring is conducted monthly from August to March and twice monthly from April to July

In the last two years, a great deal of attention has been focused on the problems of the upper Clark Fork River.

Federal efforts to mitigate the many decades of abuse began several years ago with EPA's designation of Silver Bow Creek as a non-controlled hazardous waste site under the Superfund Program In September 1984, a

remedial investigation (RI) began on Silver Bow Creek under the auspices of the DHES through a cooperative agreement with EPA. An intensive, one-year, contracted study of water quality was done and included 36 sites on Silver Bow Creek and major tributaries, the Warm Springs ponds and the upper Clark Fork River. The RI also attempted to identify and establish the extent of pollution from tailings and other sources in the Silver Bow Creek drainage and floodplain, and determine the operational status of the Warm Springs treatment ponds. DHES personnel met regularly with the RI contractor before and during the study to provide and to review water quality data. A draft RI report has been prepared and is being reviewed.

During the spring of 1985, the EPA, in conjunction with the Superfund activities, conducted bioassays on water from several Silver Bow Creek and upper Clark Fork sites. An EPA mobile field laboratory was set up on the Clark Fork at Deer Lodge in early May 1985 in anticipation of the spring spate and the elevated metals associated with it. Thirty-day, flow-through tests on "green" and eyed trout eggs and a thirteen-day, flow-through test on rainbow trout fingerlings were conducted with Clark Fork water and a tributary control. However, high streamflows failed to materialize due to record low precipitation and mountain snowpack, and the results of the bioassay were inconclusive.

A seven-day, static replacement bioassay using a waterflea (Ceriodaphnia) also found no significant toxicity at any of six upper Clark Fork stations below the Warm Springs ponds, but found acute toxicity with 100% mortality at each of three Silver Bow Creek stations. DHES personnel provided field assistance with the Ceriodaphnia bioassays which were conducted in a second EPA mobile lab near Missoula and required the delivery of fresh water samples daily.

During 1984-85 the EPA administered an emergency effort to control seepage of Pentachlorophenol/diesel fuel-contaminated groundwater to Silver Bow Creek. The seep emanated from a large volume of the material that had saturated the soil under the Montana Pole wood treatment plant in Butte. While control efforts were largely successful, additional reclamation may be needed in the future.

The purpose of the DHES monitoring has been to: 1) monitor the MPDES discharge from the Warm Springs Pond No. 2 for compliance with permit limits, 2) assess the seasonal contributions of water pollutants from various sources and the effectiveness of the Warm Springs Ponds treatment system, 3) measure any water quality changes resulting from the suspension of AMC operations or Superfund cleanup activities and 4) evaluate water quality in the two reaches of the upper Clark Fork that have "C" classifications (C-2 from Warm Springs Creek to Cottonwood Creek at Deer Lodge and C-1 from Cottonwood Creek to the Little Blackfoot River) and in Silver Bow Creek, which is classified as "F" in its entirety. If improvements in water quality are realized through Superfund or other reclamation efforts, it may be possible to upgrade the classifications of these reaches.

While it is hoped that water quality continues to improve in the upper Clark Fork, it is by no means guaranteed. Gains are becoming more

difficult to achieve due to the magnitude of remaining problems, such as the Colorado and Ramsay Flats tailings and the widespread contamination of the river floodplain

A major problem is the bypass of untreated Silver Bow Creek water directly into the Clark Fork when streamflows exceed the inlet capacity of the Warm Springs Treatment Ponds. Such an event in August 1984 killed an estimated 10,000 brown trout and whitefish in the upper river after an intense thunderstorm. The most recent bypass event occurred in February 1986. Unseasonably warm temperatures caused a rapid melting and runoff of lowland snowcover and resulted in high flows Concentrations of copper and zinc in the upper Clark Fork exceeded the maximum levels measured by the DHES since monitoring was began in 1973. The high metals were probably due in part to erosion of metals-containing deposits along the river, in addition to untreated Silver Bow Creek water that was bypassed around the ponds. Impacts of this event on aquatic life have yet to be assessed.

The fact that the Warm Springs Treatment Ponds cannot handle high Silver Bow Creek flows greatly reduces their effectiveness as the front line defense for the upper Clark Fork In addition, the volume of the ponds is presently much less than at the time of their construction in 1954 due to the settling of sediment and metal precipitates. Their continued positive influence seems uncertain

If Superfund cleanup activities begin on Silver Bow Creek and along the Clark Fork, it is uncertain what the effects will be on water quality. Removing tailings could result in increased metals and sediment pollution, since most are in close proximity to surface waters Any efforts to renovate the Warm Springs Ponds could also cause downstream impacts due to the nature of the accumulated wastes.

Mining in the Butte area may be down, but by no means out. In 1985, portions of the AMC mining properties were sold to Washington Corporation, a large Montana-based heavy construction company. The company intends to resume mining if the copper market improves. What effects renewed mining and mineral processing would have on Silver Bow Creek and the upper Clark Fork cannot be predicted, but it is certain advanced waste treatment would be required.

The winter and spring of 1985 were exceptionally dry over much of Montana, and the upper Clark Fork drainage was no exception. The subnormal snowpack and spring precipitation were aggravated by warm temperatures and an early runoff. The result was record low flows in the Clark Fork and its tributaries. The river near Dempsey nearly ceased flowing in July due to irrigation withdrawals. Temperatures became critically high for cold water aquatic life along much of the river, and dense algal mats choked much of the remaining channel. Although some fish likely died in isolated reaches, a disaster of major proportions was averted, thanks to significant rains and cool temperatures in August and September.

The future of the upper Clark Fork is undoubtedly brighter than its tarnished past, although it is uncertain whether the stream can

ever achieve its full potential. The challenge of the future will be to overcome the major problems that remain on Silver Bow Creek and the upper Clark Fork, while at the same time safeguarding the hard won improvements in water quality and biological health. The need for continued vigilance through a comprehensive monitoring program is now more critical than ever before.

Lower Clark Fork River

During the preparation of the 1984 report on Montana water quality, the largest water quality monitoring project ever undertaken by the DHES was just beginning. The Lower Clark Fork River Study was begun following public concern over the general health of the river. Much of the concern stemmed from the proposed modification of the wastewater discharge permit for the Champion International (now Stone Container) kraft paper mill at Frenchtown. Others feared that the City of Missoula wastewater treatment plant (WWTP) discharge and toxic metals originating upstream in the historic Butte Mining District were taking their toll on the river.

The two-year study began in March 1984 and coincided with issuance of a modified discharge permit by the DHES to the Champion mill. The new permit allowed Champion to increase its yearly load of suspended solids to the river and to discharge year-round, but only when flows in the river exceeded 1,900 cubic feet per second (cfs). Before, Champion could not discharge below a river flow of 4,000 cfs, which limited discharges to a several month period in the spring.

The focus of the study was aimed at examining the instream consequences of the Missoula WWTP and Champion discharges -- the two largest discharges to the lower Clark Fork -- and the fates and effects of the metals downstream from their headwater sources. With this first major monitoring program on the lower river, the DHES also hoped to establish water quality trends and general conditions, and to identify any other significant sources of pollution.

The monitoring network included 31 fixed water quality stations on the lower 225 miles of the river, in its four mainstem reservoirs and in its three major tributaries -- the Blackfoot, Bitterroot and Flathead Rivers. Conditions were also monitored in eleven deep pools and slow-water areas between the Champion mill and the Thompson Falls Reservoir. Sampling was done monthly, and more frequently during the spring high water season. A total of 30 monitoring runs were made between March 1984 and March 1986.

Many chemical, physical and biological water quality variables were measured in several thousand samples collected from the Clark Fork and its tributaries and the deepwater pools and reservoirs. Nutrients, metals and suspended solids, especially organic solids, were the pollutants of primary interest. Biological measurements centered on various aspects of the river and reservoirs' algae and invertebrate communities.

In addition to the monitoring program outlined above, several other special investigations were conducted by the DHES on the river in 1984-1985. These included two diurnal dissolved oxygen studies during the summer low flows at 12 river stations, a dye study to determine time of flow between monitoring stations and a diurnal chemical analysis of the Missoula Wastewater Treatment Plant effluent. Contracts were let to the University of Montana to measure phosphorus, organic matter and metals in bottom sediments from mainstem reservoirs and to conduct a benthic river metabolism study. The EPA assisted with the effort by conducting a 30-day chronic toxicity bioassay of the river and Champion wastewater using juvenile rainbow trout and a water flea (Ceriodaphnia), and by performing a series of algal bioassays on water from various reaches of the river.

Joining the DHES in the studies of the lower Clark Fork have been the Montana Department of Fish, Wildlife and Parks (DFWP), the State of Idaho Division of Environment, the U S Geological Survey, Champion International, university researchers and citizen's river watcher groups.

Relevant data from the various investigations were the basis for a two-volume Lower Clark Fork water quality data report and a draft environmental impact statement (EIS) on the reissuance of the Champion wastewater discharge permit, which expired in April 1986. An addendum to the draft EIS was prepared to enlarge on permitting alternatives, nondegradation, mixing zone, monitoring plans, and other topics. Some of the key findings of the lower Clark Fork monitoring included:

Metals

1. Highest metals concentrations were measured at Turah, the uppermost station in the study reach. Metals steadily decreased in a downstream direction due to dilution from cleaner tributaries

2. Copper appeared to pose the greatest potential toxic threat to fish and other aquatic life

3. Up to 150 miles of the 225 miles studied were periodically subjected to copper pollution. The criteria for protection of aquatic life were exceeded at all mainstem sites at least once from Turah to below the Flathead River confluence

4. Exceedences of the copper standard were infrequent in 1984-1985, of short duration and usually dependent on streamflow (associated with high flows). An exception was an exceedence below Milltown Dam during an operational drawdown.

5. There was no indication that the discharge of organic solids from point sources lowered the dissolved oxygen and pH of the reservoirs and deep river pools and thereby increased the mobility of metals contained in bottom sediments. This had been mentioned as a possible consequence of the increased discharge of organic solids from the Champion mill.

Nutrients

1. Average nitrogen and phosphorus concentrations were greatest at Turah. Cleaner tributaries entering the Clark Fork downstream diluted the nutrient levels.

2. The Missoula WWTP and Champion discharges temporarily increased nutrient concentrations nearly to the levels recorded at Turah. Nitrogen and phosphorus represented on the average 16 and 34 percent (Missoula WWTP) and 12 and 19 percent (Champion discharge) of the loads present in the river below each of those discharges.

3. The temporary increase noted above was followed by a steady decline in nutrient concentration downstream from the Champion mixing zone to below from the Noxon Rapids Dam, where the lowest average levels were recorded.

4. An average 23 percent of the nitrogen and 43 percent of the phosphorus load in the Clark Fork above Thompson Falls was removed by the Thompson Falls and Noxon Rapids Reservoirs.

5. The Clark Fork is primarily phosphorus-limited where it passes the Champion mill.

6. Nutrient concentration guidelines for avoiding attached nuisance algae growth in the river were not exceeded below the Missoula WWTP or Champion discharges.

7. Guidelines for avoiding blooms of suspended algae were exceeded in a third of the samples collected above Thompson Falls, where the series of reservoirs begins. However, measured reservoir algae concentrations were well below the eutrophication problem threshold.

Suspended Solids

1. Highest average concentrations of suspended solids were found at Turah, followed by a downstream decrease due to dilution by cleaner tributaries.

2. Neither the Missoula WWTP nor Champion discharges caused measurable increases in suspended solids concentrations or loads in the Clark Fork.

3. About 82 percent of the average daily suspended solids load in the river above Thompson Falls was trapped in Thompson Falls and Noxon Rapids Reservoirs. The amount settling out in the two impoundments averaged more than 600 tons/day.

Dissolved Oxygen

1. Dissolved oxygen concentrations slightly below the applicable B-1 water quality standard of 7 mg/l were measured once at each of the following locations: the bottoms of Noxon Rapids and Cabinet Gorge Reservoirs, in the Clark Fork below Noxon Rapids Dam and in the lower Flathead River.

2. MPDES self-monitoring records indicate it is likely that the Missoula WWTP discharge is responsible for seasonal reductions below the 7 mg/l standard in the Clark Fork for more than 13 miles downstream.

3. The oxygen demand of the Champion wastewater discharge appears to be exerted primarily within the wastewater mixing zone, but other studies indicate its maximum effect is felt below the mixing zone. It is unlikely that the discharge further reduces river dissolved oxygen concentrations below those attributable to the Missoula WWTP discharge.

Toxic Substances

1. Copper toxicity is a potential problem in the lower Clark Fork, although instream biotic problems have not yet been documented.

2 Un-ionized ammonia concentrations exceeding guidelines for the protection of aquatic life were common in the Clark Fork within the Missoula WWTP discharge mixing zone

3. The Champion wastewater discharge contains ammonia, hydrogen sulfide and organic resin acids. All of these compounds are potentially toxic. While it seems unlikely that acute or chronic toxicity problems would occur in the Clark Fork following the minimum river water to waste water dilution ratio of 200:1, further investigation is warranted.

Aesthetics

1. The increased presence of river foam was determined to be a significant problem below the Champion mill.

2. Evaluations of game fish flavor and odor indicated that fish tainting problems due to the Champion wastewater discharge were unlikely.

3. Peaking power operations of hydroelectric facilities and reservoir drawdowns created significant aesthetic problems in the Clark Fork below the Flathead River by altering river and reservoir water levels.

Periphyton Community

1. Periphyton production in the Clark Fork was highest between Missoula and Huson due to nutrient additions from point source discharges.

2. Periphyton production above and below the Champion mill was similar. Champion's wastewater discharge did not appear to stimulate or inhibit periphyton growth over that measured above the mill

3. The average number of species and diversity of diatom algae at all stations sampled in the lower Clark Fork were comparable to those measured in unpolluted Montana streams.

4. Pollution sensitive species dominated the diatom communities at all of the lower Clark Fork stations examined, except in the mixing zone of the Missoula WWTP discharge.

5. The distribution of Clark Fork diatom species among three pollution indicator groups was nearly identical above and below Champion Pollution sensitive species dominated, indicating that organic, oxygen-consuming pollutants were not a problem

6. Average diatom diversity in the Clark Fork below the Missoula WWTP discharge mixing zone, although within the range of unpolluted streams, was the lowest of all sites suggesting some stress from inorganic nutrient additions.

7. Average diatom diversity increased below the Champion mill, indicating that Champion's discharge did not further stress the periphyton community.

Macroinvertebrate Community

1. The lower Clark Fork throughout the study reach supported a rich, highly diverse macroinvertebrate community More than 200 different species were identified, and as many as 60 species were present at one time at individual sampling stations

2. The data indicated a healthy, not heavily stressed river environment, but one which has undergone some degree of degradation in the past.

3. Macroinvertebrate abundance data indicated that fish food availability was probably not a factor limiting Clark Fork trout populations.

4. Substantial changes in macroinvertebrate community composition occurred below the Flathead River confluence and below the lower Clark Fork hydroelectric dams. However, diversity and general community health remained high

5. Macroinvertebrate samples from the mainstem reservoirs indicated a severely stressed environment at Milltown Reservoir; a stressed but

improved environment at Noxon Rapids Reservoir, and generally favorable conditions in Thompson Falls and Cabinet Gorge Reservoirs.

6. The Missoula WWTP discharge caused no apparent reduction in Clark Fork macroinvertebrate community health despite low river flows and low wastewater dilution in summer 1985. An increase in macroinvertebrate abundance was noted for a short distance downstream from the discharge

7. A subtle, localized impact was seen immediately below the Champion discharge, especially in the fall of 1984. No significant problems were indicated below the wastewater mixing zone

Riffle Community Metabolism Study

1. The discharge of wastewater from the Champion mill had no measurable effect on the metabolic rates of the riffle communities downstream from the mixing zone.

2. High concentrations of nutrients in the Clark Fork above Champion supported high riffle community metabolic rates, which may have masked the impact of the Champion discharge.

3. No water column metabolism was measured in the Clark Fork at stations above or below Champion.

Reservoir Sediment Studies

1. Copper and zinc concentrations in bottom sediment core samples from Thompson Falls, Noxon Rapids and Cabinet Gorge Reservoirs were much lower than those measured in the Clark Fork portion of Milltown Reservoir. Concentrations decreased with distance downriver from Milltown.

2. However, concentrations of copper and zinc in the downstream reservoirs were elevated compared to levels in the Blackfoot part of Milltown Reservoir and to levels at local tributary control sites within Noxon and Cabinet Gorge Reservoirs.

Continuing Monitoring

Public awareness of the Clark Fork's problems has greatly increased over the last several years. Consequently, there has been a flurry of activity aimed at investigating and correcting these problems. Three of Montana's Superfund sites, plus an Abandoned Mine Land (AML) reclamation project administered by the DSL, are located in the basin. Sewage treatment plants are being upgraded, the Montana Power Company is planning the reconstruction of Milltown Dam and the DFWP is applying for an instream flow reservation.

Meanwhile, the Anaconda Company has ceased operations, the Berkeley Pit is filling with water and the long-term effectiveness of the Warm

Springs Ponds is in doubt. Montoro and ASARCO are planning to open major new metal mines in the basin.

All of these activities and many others could change the water quality of the river for many years to come. As a result, the Montana DHES has designated the entire Clark Fork as a priority water body and Governor Schwinden has established the Clark Fork Basin Project to coordinate efforts to improve or maintain water quality. Presently, nearly 50 studies that address water resources in the Clark Fork Basin, excluding the Flathead, are planned, in progress or recently completed. However, none contains a plan to monitor the long-term and cumulative effects of past, present and future impacts to the water quality in the river.

Beginning in October 1985, following the collection of the last set of data to be used in preparing the Champion EIS, the Water Quality Bureau combined its upper and lower Clark Fork River monitoring programs. Some changes in stations monitored and parameters measured were necessary to meet program objectives.

Two stations were added on upper Silver Bow Creek to complement the eight locations which had been regularly monitored in the upper river. Two additional Clark Fork stations were located in the 76-mile reach of river from Garrison -- where the former upper river monitoring left off -- to Turah -- where the lower river study began. Twelve of the 31 lower river stations were discontinued. Most of the stations dropped were within the Missoula WWTP and Champion discharge mixing zones or in the four mainstem reservoirs, which in the past had been monitored a limited number of times each year. The number of stations which are now regularly monitored along the lower river represents an increase over the former study -- from 16 to 18.

The DHES now collects data approximately 16 times a year (monthly from August through March, twice monthly from April through July) at 30 fixed stations on the Clark Fork River and its major tributaries from Silver Bow Creek to the Idaho border (Figure 6-2). Parameters measured are selected metals, nutrients, total and organic suspended solids, and others such as hardness and alkalinity which affect metals toxicity. Biological monitoring for invertebrate organisms and periphyton is scheduled to be conducted once per year at each of the 30 stations.

This long-term comprehensive monitoring program will: allow the DHES to detect possible violations of ambient water quality standards; monitor the biological health of the river; document any changes in water quality that might occur from development, reclamation and pollution control efforts; and supplement the existing data base for water quality management decisions (e.g., issuance or reissuance of wastewater discharge permits).

6.4.2. FLATHEAD LAKE

Evidence of cultural eutrophication in Flathead Lake (see Section 5.1.) has prompted more intensive and extensive water quality monitoring in the Flathead Basin.

Beginning July 15, 1984, the DHES contracted with the University of Montana Biological Station on Flathead Lake to monitor the amounts of algal nutrients entering and leaving the lake and the amount of algal growth in the lake itself. About the same time, the Biological Station applied for and received funds from the EPA to determine the bio-availability of phosphorus from different sources within the basin Results from this study will be released in the spring of 1986 Additionally, the station, together with the Montana Bureau of Mines, is beginning a major study to identify sediment and phosphorus sources in the North Fork drainage of the Flathead River

In January 1985, supported by a $10,000 grant from the Flathead Basin Commission (see Section 6.5.1.), Dr. Jack Stanford of the University of Montana Biological Station prepared a Master Plan for monitoring the quality of surface waters in the Flathead Basin.*

The plan is a cooperative venture, ultimately involving the technical and financial support of up to 15 public agencies and private corporations. Its goal is to obtain a ten-year record of water quality conditions and trends at 80 key sites in the Flathead Basin

At the core of the Master Plan is an $86,000-per-year effort to measure in-coming phosphorus to and the eutrophication status of Flathead and Whitefish lakes. The DHES share of this effort is $26,000 a year. The responsibility of the DHES under the Master Plan is to fund the collection and analysis of samples pertaining to the eutrophication of Flathead Lake. Such information will be used to evaluate progress under the Flathead Lake Phosphorus Strategy (see Section 6 5 2.) and to make adjustments as necessary to achieve desired water quality goals

6.4.3. ASHLEY CREEK

Ashley Creek, a small tributary to the lower Flathead River, was identified in 1982 and 1984 as having man-caused water quality problems that could be improved significantly by existing regulatory authority and pollution control programs--funds permitting

The Kalispell Wastewater Treatment Plant (WWTP) provides secondary treatment to municipal wastewater from the City of Kalispell and outlying areas before discharging the effluent to Ashley Creek. Due to the smallness of the stream relative to the large volume of discharge, pollutant concentrations instream are high. Currently there are no effluent limitations on maximum amounts of nitrogen and phosphorus that can be discharged to the creek; 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) concentrations and loads are limited under the existing MPDES permit.

The Montana Surface Water Quality Standards place Ashley Creek above Smith Lake in the B-1 water-use classification and from Smith Lake to the Kalispell WWTP discharge in the B-2 water-use classification The

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* Stanford, J.A. January 1985. Monitoring Surface Water Quality in the Flathead Basin: Master Plan. Open File Report, Flathead Lake Biological Station, University of Montana, Bigfork. 23 pp.

creek downstream from the WWTP outfall to its confluence with the Flathead River is classified as C-2. This last reach was upgraded from an E classification in 1980 in response to measured and anticipated water quality improvements following WWTP upgrades in the mid 1970's. A minimum instream flow above the WWTP of 15.8 cubic feet per second was guaranteed with the purchase of water rights by the Montana Department of Fish, Wildlife and Parks in 1977. It was hoped that water quality in lower Ashley Creek would eventually allow for the "growth and marginal propagation of salmonid fishes" as stipulated under both the B-2 and C-2 classifications, and allow fish passage to and from the Flathead River.

The B-2 and C-2 classifications have the same minimum instream dissolved oxygen standards: 6 milligrams per liter (mg/l) in summer and 7 mg/l during the remainder of the year. Both classifications give the same amount of protection to aquatic life, including salmonid fishes. Suitability for drinking and culinary use after conventional treatment is required under the B-2, but not the C-2 classification.

A DHES Ashley Creek study in August 1984 was aimed at establishing existing conditions and determining if water quality standards were being met. Four sampling sites were chosen from just above the WWTP to just above the mouth. Water samples for chemical and physical parameters were collected at the sites and from the WWTP discharge. Included were nutrients (nitrate nitrogen, total ammonia, kjeldahl nitrogen, ortho and total phosphorus), selected common ions (sodium, chloride and sulfate), BOD_5, TSS, turbidity and pH. Stream biology samples included periphyton algae and macroinvertebrates. Temperature and DO measurements were taken at three-hour intervals over a 24-hour period during August 22-23, 1984 to determine diurnal variability.

The diurnal DO monitoring revealed that the B-2 standard of 6 mg/l minimum DO was violated above the WWTP by a small margin during the pre-dawn hours. Much more serious and prolonged violations of the 6 mg/l minimum occurred in the C-2 reach below the WWTP. At the site about a mile below the WWTP, DO concentrations over the 24-hour period did not rise above 2.5 mg/l, and sagged to only 0.3 mg/l just before dawn. This monitoring was conducted during the time of year when the greatest extremes in diurnal DO concentrations could be expected. High instream water temperatures, in excess of 20°C during late afternoon, reduced the solubility of oxygen while increasing its consumption by elevating the respiration rates of the stream biota.

Above the WWTP, the high consumption was greatly offset in the daytime by oxygen produced by aquatic macrophytes and algae during photosynthesis, and DO maxima approached 14 mg/l. Below the WWTP, DO concentrations were critically low during the entire 24-hour period for many forms of aquatic life, especially salmonid fishes. Although very heavy growths of aquatic plants were present below the WWTP, DO concentrations did not exhibit the afternoon peak seen above the WWTP. This phenomenon could not be adequately explained by the BOD of the wastewater alone, which was relatively low and well within effluent limits. Biological samples collected below the WWTP revealed very large numbers of pollution-tolerant crustaceans (isopods) within the extensive clumps of rooted aquatic plants. It is probable that the combined

oxygen demands of crustaceans, aquatic plants and microbes, plus decaying organic matter and sludge deposits was large enough to severely depress the DO concentration, especially during periods of darkness.

The great abundance of organisms present in the reach of Ashley Creek below the WWTP indicated nutrient enrichment, and this was confirmed by the chemical data. Primary (plant) production in the creek above the WWTP was phosphorus-limited, as indicated by the nitrogen to phosphorus (N/P) ratio of greater than 10. Below the WWTP, nitrogen became the growth-limiting nutrient (N/P < 10) due to the large increase in phosphorous. Concentrations of phosphorus in the effluent ranged from 2-6 mg/l and total phosphorus concentrations one mile below the WWTP were 20-100 times greater than the concentrations measured above the WWTP.

If the dissolved oxygen standards specified under the C-2 classification were to be realized in lower Ashley Creek, it was evident that effluent limitations placed in the Kalispell WWTP discharge permit would need to be tightened. A preliminary environmental review (PER) to propose necessary permit modifications was prepared by the DHES in August 1985.

Three discharge alternatives for the Kalispell WWTP effluent were evaluated for water quality effects: 1) continued discharge to Ashley Creek, 2) direct discharge to the Flathead River and 3) no surface water discharge. Two scenarios were considered for the continued discharge to Ashley Creek: year-round discharge and seasonal discharge. The direct discharge to the Flathead River above the mouth of Ashley Creek was rejected because it would cause degradation of existing high quality water, which cannot be allowed.

To eliminate the surface water discharge would require effluent storage and an alternative method of disposal, such as land application. While this option would effectively eliminate impacts to surface water, local ground water could be affected. The feasibility of this alternative could not be determined with the available data.

The scenario to continue year-round discharge to Ashley Creek failed to provide reasonable assurance that Water Quality Standards could be met, even if improvements in effluent quality were attained. Data from recent DHES and DFWP monitoring, and additional data collected during the last six years, indicated that violations of the C-2 standards for DO occurred from May-September of a typical year with continuous discharge.

The likely need to require a no-discharge period that covered at least the summer months was identified early in the PER process. This would necessitate storage and/or land application during the months when minimum instream DO standards would be violated. It was proposed that no discharge be allowed from May 1 - September 30 of each year.

Effluent limitations on the Kalispell WWTP were proposed for the period October 1 - April 30 of each year. These included a 1 mg/l limit on total phosphorus, which is consistent with the basin-wide strategy to

reduce phosphorus inputs to Flathead Lake (See Section 6.5.2.) To attain this limit would require the addition of phosphorus-removal technology to the WWTP. Additionally, limits for 30-day average and maximum total ammonia concentrations were proposed (ammonia is toxic to aquatic life and removal may be required to meet these limits).

The DHES has not finalized the proposed modifications to Kalispell's discharge permit. Once adopted, a compliance schedule will be drawn-up and will indicate what Kalispell must do to meet the new limits. A major share of the costs would be covered under the Construction Grants Program. (See Section 6.1.1.)

Meanwhile, the DHES will continue to monitor Ashley Creek, although it is unlikely that intensive monitoring will resume until plans to upgrade the Kalispell WWTP are finalized. At that time the department will likely initiate an intensive before-and-after study (See Section 6.4.4.) to document improvements in the water quality and biological health of lower Ashley Creek.

6.4.4. WASTEWATER TREATMENT PLANT (WWTP) UPGRADE STUDIES

To document and demonstrate the water quality improvements resulting from multi-million dollar expenditures of construction grant funds, the DHES decided to do before-and-after studies of the receiving streams for five treatment plant discharges. A summary of one such study for the East Gallatin River (Bozeman) was included in the 1984 305(b) Report. This study documented an improvement in water quality due to upgrading the Bozeman WWTP.

In 1983 and 1984, monitoring was done to document the "before" conditions at four other sites. Construction grant projects in Lewistown (Big Spring Creek) and Hot Springs (Hot Springs Creek) should be complete by Fall 1986. Construction at Hamilton (Bitterroot River) is complete, and work at Kalispell (Ashley Creek) is in progress. (See Section 6.4.3. for a discussion of monitoring on Ashley Creek.) The "after" studies await completion of the construction phase, and a "shakedown" period to allow stabilization of plant operations and recovery in the impact zone. If construction proceeds as scheduled, all studies should be complete by late 1987, with the exception of Kalispell.

Because of concern for the Clark Fork River, a reassessment of the impact of ammonia loadings from the Missoula WWTP was considered necessary. (See also Section 6.4.1. for results of other studies conducted in the Clark Fork River below the Missoula WWTP.) An assessment done in 1981, based on an on-site rainbow trout bioassay conducted with EPA assistance, concluded that ammonia removal was not necessary to protect aquatic life. The reassessment considered data obtained during recent Clark Fork River monitoring (Section 6.4.1.), Missoula WWTP self-monitoring data, the findings of the 1981 fish bioassay, and EPA ammonia criteria. An analysis, based on the 7-day, 10-year (7Q-10) low flow and a "worst-case" condition of maximum instream temperature and pH, concluded that the design loading of 579 lbs/day of ammonia was not sufficient to protect aquatic life at all

flows above the 7Q-10 flow The "worst-case" scenario, however, would be an extremely rigid approach. A more sophisticated method would be desirable to assess the potential for ammonia toxicity below the Missoula WWTP.

The DHES recently has taken an enforcement action against the City of Missoula for violation of MPDES effluent limits. The DHES also has asked the EPA to conduct an on-site trout bioassay on the Missoula WWTP effluent in the spring of 1987, after the city has completed remedial construction at the plant. The MPDES discharge permit for Missoula will come up for renewal in the fall of 1987.

6.4.5. FREEZEOUT LAKE/TETON RIVER

The Teton River, one of Montana's priority water bodies, has been degraded for more than 20 years by saline discharges from Freezout Lake (See also Section 5.7.) Freezeout Lake is a waterfowl refuge managed by the DFWP. The lake serves as a sink for irrigation return flows and drainage from the Greenfields Irrigation District. Evaporation exceeds precipitation in the area, thus salts in Freezeout Lake are concentrated. The only outlet from Freezeout Lake is a man-made canal to the Teton River through Priest Butte lakes. This drainage canal was constructed in the 1950's when rising water levels in the lakes threatened to inundate a nearby highway and a railroad. The increasingly saline discharges to the Teton River from the lakes have impaired downstream irrigation uses and adversely affected aquatic life

A water quality management plan was prepared by the DHES for the Freezeout-Priest Butte Lakes/Teton River in early 1984 The plan included a system for releasing water from the lakes to keep downstream Teton River conductivity levels below 1,000 micromhos, and a monitoring program. (Electrical conductance of the water was used as a simple, substitute measure of salinity.) The water release system consisted of: 1) a control structure and flow measuring device at the lake outlet, 2) a staff gage and rating table for determining Teton River flows and 3) a series of tables giving allowable lake discharge rates at given river flows and discharge conductivities. Staff from the DHES and the waterfowl refuge implemented the plan the same year, and have continued to work together to refine the plan Follow-up monitoring was performed in 1984 and 1985 to document water quality improvement in the Teton River.

For several months following implementation of the plan, Teton River conductivity occasionally exceeded the maximum target level of 1,000 micromhos. However, conductivity remained far below that measured in earlier years. Following additional calibration of the water-release guidelines and the installation of a more efficient headgate at the lake outlet, river conductivity was maintained well within the range of acceptable levels for the remainder of the year (average 914 micromhos). The drought conditions in 1984 resulted in low Teton River flows and required extra vigilance on the part of the refuge staff to maintain proper dilution of the lake discharges.

Low runoff occurred again in 1985, and Teton River flows were below normal. Low inflow rates to Freezeout Lake coupled with high evaporation resulted in a water deficit rather than a need to discharge. Salinity in the lake reached an all-time high. There was concern the plan would need modification to protect the Teton River from more saline discharges. Fortunately, the drought was reversed with heavy rains in August 1985, and water levels rose. Because of runoff dilution, lake salinity levels returned to near normal.

A discharge from the lakes was not required in 1985. Monitoring conducted from April through June and in October 1985 recorded average and maximum river conductivities of 650 and 740 micromhos, respectively, well below the maximum acceptable level.

Less frequent monitoring will be conducted in 1986 to assure continued protection of Teton River uses and to further refine the plan as needs arise.

6.4.6. STANLEY CREEK/LAKE CREEK

At the headwaters of Stanley Creek in the Lake Creek drainage of northwestern Montana, ASARCO Incorporated operates the Troy mine. Begun in 1979, the underground operation is one of the largest silver mines in the United States, and is also a significant producer of copper. The accompanying mill is designed to handle 8,500 tons of ore per day.

The ore body is mined using the "room and pillar" method, in which large pillars of solid rock are left in place to support the roof of cavern-like excavations, or rooms. The ore is coarsely crushed underground, then conveyed to the surface for final crushing and grinding. A flotation process is used to separate particles of the copper and silver mineral from a slurry of the pulverized rock. The valuable minerals collect at the surface as a froth. The froth is skimmed and filtered to yield a solid concentrate. The finely-ground waste rock, or tailings, are conveyed in slurry form by gravity-flow pipeline to a tailings impoundment adjacent to Lake Creek, 6.5 miles away and 1,000 feet below the mill site. Decant water from the tailings impoundment is recycled to the mill for reuse. The impoundment will ultimately cover about 350 acres.

Under the operating permit issued by the DSL, ASARCO is required to monitor water quality at several locations on Lake Creek, the tailings pond, and on Stanley Creek. In addition, the USFS requires ASARCO to monitor three sites on upper Stanley Creek under the provisions of a special use permit issued for the Troy operation. Both permits require water samples to be collected three times a year, once during the spring, summer and fall. ASARCO began self-monitoring soon after the Troy operation opened, and has been reasonably consistent in meeting the required sampling schedule. A comprehensive list of 27 chemical and physical parameters is currently required, and while these have varied somewhat since the inception of self-monitoring, they have generally been adequate to characterize water quality.

Questions have arisen concerning the accuracy and validity of analyses performed by ASARCO's Salt Lake City laboratory While its quality assurance program has been deemed acceptable by the State of Utah for lab certification, serious exceedences of EPA maximum holding times for a number of parameters may have resulted in invalid data. The full extent of this problem remains unknown since analysis dates were not provided with all data reports. ASARCO was notified that it must adhere to EPA's maximum sample holding times

Baseline water quality monitoring in Stanley Creek and Lake Creek for the ASARCO-Troy Mine EIS was done in 1977-78 by the DHES. Since the mine opened in 1980, the department has continued occasional monitoring, either in conjunction with ASARCO's sampling or in response to special concerns. Comparisons of data from DHES/ASARCO split samplings have generally been favorable, although unexplained discrepancies have occurred

The DHES did baseline biological monitoring for periphyton and macroinvertebrate communities in Stanley Creek and Lake Creek ASARCO was not required to continue instream biological monitoring under the operating permit issued by DSL Instead, a 48-hour acute toxicity bioassay program was implemented that used the waterflea Daphnia as the test organism. Bioassays were conducted three times yearly on water from Lake Creek upstream and downstream from the tailings impoundment, on tailings decant water and on groundwater from five monitoring wells in the vicinity of the impoundment Results of several years of bioassays were largely inconclusive other than establishing the lack of acute toxicity of tailings decant water to Daphnia.

Follow-up periphyton monitoring done by the DHES in 1982 and 1984, and macroinvertebrate monitoring conducted in 1984, revealed decreases in the number of taxa and species diversity in Lake Creek compared to baseline data Concerns that ASARCO was subtly impacting the biota in Lake Creek prompted changes in the biological monitoring required under the operating permit. Under the new monitoring plan, ASARCO is required to collect and analyze quantitative macroinvertebrate samples three times a year to provide information that is more comparable to baseline data. Three sites on Lake Creek (one upstream and two downstream of the tailings impoundment) and one site on each of Stanley and Fairway creeks are included in the monitoring, which began in August 1985. ASARCO continues to conduct 48-hour acute toxicity bioassays with Daphnia on the tailings impoundment decant water.

Because of the soft (low total hardness) surface waters in the Lake Creek drainage, the maximum allowable concentrations of heavy metals, as determined by the EPA criteria for the protection of aquatic life, are very low. Minimum detection limits attainable using standard atomic absorption (AA) instruments are often greater than the concentrations of copper, cadmium and other metals that are considered to be toxic. Concerns that ultra-low, but potentially harmful concentrations of heavy metals might be escaping detection prompted the DHES to include Stanley Creek and Lake Creek in a special sampling effort planned for April and May 1985 on the lower Clark Fork River. (See Section 6.4.9) A contract was let for metals analyses to be performed using graphite

(carbon) furnace AA instrumentation, which is capable of measuring ultra-low metals concentrations

To minimize background contamination, sample containers were given special cleaning and pure nitric acid was used as a preservative Quality control requirements were stringent to assure confidence in the precision and accuracy of the analyses Samples were collected by DHES personnel twice monthly during April and May, 1985, from four locations on Stanley Creek, three on Lake Creek and one on Fairway Creek

Streamflows during the sampling period were up due to snowmelt runoff and rainfall, and were likely in excess of average flows for that time of year Very high turbidity was noted in lower Stanley Creek in early April, when the headwaters were still under several feet of snow. The total recoverable (acid soluble) copper concentration at that time was nearly 200 times the criterion, and more than 50 times the detection limit of conventional AA techniques. Subsequent samplings near the end of April and in early and late May revealed much lower concentrations of copper in Stanley Creek, but criteria for the protection of aquatic life were exceeded. Turbidity was visibly lower in Stanley Creek in late April, and sediment deposits were observed in the pool areas of the stream channel. Increased flows in May apparently flushed out much of this material, since it was not observed later in the summer Exceedences of criteria for cadmium, lead and silver were documented in Stanley Creek throughout the sampling period, at concentrations generally below conventional AA detection limits In late May, the criterion for silver was exceeded at all sites on Lake Creek, Stanley Creek and Fairway Creek by significant margins

To identify likely sources of the elevated metals in Stanley Creek, the DHES made field surveys and collected samples on two occasions, during August and October of 1985. It was believed that the metals were contained in sediment and mine tailings eroded from deposits along the upper Stanley Creek drainage. Tailings were considered because of a spill that occurred in 1981, which did enter Stanley Creek downstream from ASARCO's mill. A sample of fine-grained floodplain sediment from this reach, collected in August 1985, was found to contain elevated levels of copper when analyzed as a solid and in aqueous suspension. This prompted a more intensive effort in October 1985 to characterize floodplain sediments from the headwaters on down, and to identify areas contributing sediment to Stanley Creek. Samples of fresh stream-deposited sediments were collected from along the creek at one site upstream from ASARCO, two sites adjacent to the mill and a site downstream, but above the location of the August 1985 sample. Samples of fresh tailings from ASARCO's tailings impoundment and weathered tailings from a 1984 pipeline break were collected for comparison.

Analyses performed on dry samples and aqueous suspensions of the material (250 mg/liter) both revealed that the lowest metals concentrations occurred in sediment from above the mill and in the tailings samples. Metals levels increased markedly with distance below the uppermost site, with the highest values measured at the site adjacent to the downstream end of the ASARCO mill Levels decreased

with distance below the mill, but remained much higher than measured above.

A number of significant sediment sources were identified along Stanley Creek, all of them adjacent to the ASARCO mill site. Very steep banks of unstable and unvegetated fill material pushed over the natural hillside during mill site construction exhibited evidence of erosion, with significant sediment reaching Stanley Creek The erosion appeared to be caused by precipitation and snowmelt runoff from the exposed banks, and probably from the mill site itself Other sources of sediment, either natural or man-caused, appeared relatively minor in comparison.

Efforts to identify and implement solutions to the sediment/metals problem in Stanley Creek were begun in March, 1986 A report detailing the results of the DHES' field and laboratory work was distributed to ASARCO, DSL and USFS, and a meeting of the four parties was held in late March to discuss the findings and possible remedial actions. It is likely that this process will be continued on-site during the spring and summer of 1986.

The DHES plans to continue monitoring water quality in Stanley Creek and Lake Creek on a regular basis, beginning in early April 1986, when department personnel will split water samples with ASARCO during their required spring monitoring.

6.4.7. YELLOWSTONE RIVER SEDIMENT

In 1985, DHES contracted with the USGS to conduct a cooperative turbidity/sediment study on the Yellowstone River above Livingston. Other participants in the study are the USFWS and National Park Service (NPS) representing interests in Yellowstone National Park, the MDFWP, the Park County Conservation District, USDA Soil Conservation Service (SCS), and the Joe Brooks Chapter of Trout Unlimited headquartered in Livingston.

The purpose of the study was to determine the amount of sediment carried in the upper Yellowstone River and estimate the relative contributions of suspended sediment by major tributaries between Tower Junction in Yellowstone National Park and Livingston. Recently, fishing guides and anglers have been concerned with high turbidity and large amounts of suspended sediment in the Yellowstone River during late summer, after the normal snowmelt runoff. The upper Yellowstone is a world famous, high quality trout fishing stream.

Streamflow was measured and suspended sediment and turbidity samples were collected at 25 sites throughout the upper basin during the 1985 field season. Correlations were determined between streamflow, rainfall, turbidity and concentrations of suspended sediments. Historical streamflow and precipitation records were also analyzed.

Results of the 1985 study indicate that turbidity and concentrations of suspended sediment in the upper Yellowstone River are closely related to snowmelt and late summer rainstorms. Some watersheds

are more susceptible to erosion, particularly the Lamar and Gardner River drainages. The study is scheduled to continue in 1986

6.4.8. MISSOURI RIVER INSTREAM FLOW

Instream flows play an important role in maintaining the high quality waters in Montana's rivers and streams. In 1978, DHES secured instream flow reservations in the Yellowstone River to protect the quality of water for beneficial uses, such as municipal supplies, irrigation, fisheries and aquatic life. In 1985, the Montana legislature directed agencies to consider reservation of water in the Missouri River drainage.

Preliminary investigations indicated that the concentrations of some naturally occurring pollutants originating in Yellowstone National Park may approach or exceed levels that have public health significance. But better data on the concentrations and loads of pollutants in the upper Missouri River basin were needed to determine the feasibility of reserving good quality water for dilution, reducing the public health impact of these pollutants.

The DHES contracted with the USGS to measure streamflows and concentrations of selected pollutants in 24 streams in the Missouri drainage above Canyon Ferry Dam. The results of this study along with historical data, will be evaluated by DHES and, if the results warrant, an application for instream flow reservations will be prepared by DHES.

Water quality reservations would focus on dilution of pollutants, particularly heavy metals. Data collected late in 1985 indicate that heavy metal loads are highest in the Madison River. The pollutants are suspected to be closely related to geothermal activity in Yellowstone National Park.

6.4.9. HEAVY METALS SURVEY

The toxicity of many heavy metals to fish and aquatic life is a function of water hardness. The lower the hardness of a receiving water, the more toxic will be a given concentration of a metal. Many of the streams and lakes in western Montana have soft waters due to the geologic makeup of drainages. This means that a number of western Montana streams are potentially sensitive to metals pollution

During the preparation of the 1984 biennial water quality report, it was learned that the instream criteria for several heavy metals in Lake Creek near the ASARCO mine, Troy, Montana, were routinely smaller than the detection limits of the DHES Chemistry laboratory

While metal concentrations in Lake Creek seldom surpass the detection limits of the analytical techniques in use, smaller exceedences of instream criteria for the protection of fish and aquatic life can go undetected. This analytical shortfall meant that: 1) it was difficult to know precisely what the baseline levels of the metals in Lake Creek were and 2) the DHES wouldn't know if criteria were exceeded until levels were many times larger. The situation would be even more

exaggerated in other streams, such as Rock Creek near Noxon, Montana, where ASARCO has been planning to develop another large mine, and where average water hardness is much smaller than in Lake Creek.

In early 1985, the DHES received a grant from the EPA to measure low-level metal concentrations in some western Montana streams. Lake and Rock creeks and the Blackfoot, Bitterroot, Flathead and lower Clark Fork rivers were targeted for sampling. A private commercial laboratory performed the analyses using carbon furnace techniques.

The carbon (or graphite) furnace method provides analytical detection limits that are one to two orders of magnitude smaller than those provided by conventional methods. However, the method is not without its drawbacks. Extraordinary care is required to prevent sample contamination, specially cleaned bottles and pure sample preservatives must be used, along with rigorous quality assurance measures.

Sample collection began in March 1985 and continued into May. Eight stations in the Lake Creek drainage and nine stations in the Rock Creek drainage were sampled up to four times each. The Blackfoot, Bitterroot and Flathead rivers were sampled five times. Thirteen stations were sampled five times along the lower Clark Fork River and ten locations in the mainstem reservoirs of the lower Clark Fork were sampled once.

The Clark Fork and its major tributaries (Blackfoot, Bitterroot and Flathead rivers) were sampled as part of an ongoing study of that drainage. (See Section 6.4.1.) In past monitoring, metal levels in the tributaries and at some of the mainstem monitoring stations were typically below conventional detection limits, and loading calculations had not been possible.

The data generated by this study established, for the first time, the actual concentrations of copper, zinc, silver, lead and cadmium present in many of the streams sampled. Some of the Clark Fork River monitoring stations yielded metal levels that could have been measurable with conventional methods. However, some of the lower Clark Fork stations and the Blackfoot, Bitterroot and Flathead rivers generally had levels smaller than the detection limits of the analytical methods formerly used.

The occurrence of rain and snowmelt during some of the sampling raised water levels and sediment concentration. As a result, the least concentrations of metal to be expected in the streams were not established, since the lowest background metals levels would be expected during lowest streamflows. However, the runoff events were helpful in other respects. A runoff-associated metals problem was documented in Stanley Creek, a Lake Creek tributary. (See Section 6.4.6.) Several excursions from certain metals criteria were detected elsewhere in the Lake Creek drainage. However, they were noted both above and below the ASARCO mine, mill and tailings impoundment and the source(s) of the metals were not established.

The Rock Creek drainage also yielded some measurements in excess of the criteria. The drainage is mostly undeveloped at this time, except for some past logging activity and small scale historical minerals prospecting. The presence of metal ore deposits in the drainage may have been a contributing factor. If the measured metal levels are natural, background concentrations, the community of resident aquatic life in the drainage would have developed in the presence of those concentrations and would therefore be adapted to naturally occurring values of that magnitude. Additional carbon furnace metals sampling is currently being done in the drainage by a private firm as part of baseline studies in anticipation of an environmental impact statement to be prepared for the proposed ASARCO Rock Creek mine.

As time and resources allow, additional low-level metals monitoring will be done by the DHES on these and other softwater streams in the state. The information and experience gained have been invaluable. Although the precautions that are necessary to assure data validity are troublesome, the need remains to further refine and use the method.

6.4.10. QUALITY ASSURANCE

Water pollution control programs rely, to a large degree, on data derived from monitoring. It is therefore essential that all data be scientifically valid, defensible and of known precision and accuracy. These are the primary objectives of quality assurance. The DHES recognizes the importance of adequate quality assurance (QA) and is committed to the management of an acceptable QA program.

With EPA guidance, a QA Program Plan for the DHES was developed and the third revision implemented in June 1984. Under this plan the DHES participates in a centrally-managed QA program which includes those monitoring and measurement efforts supported or mandated through contracts, grants, regulations or other formalized agreements. The program covers all monitoring and measurement activities which generate and process environmental data for department use.

For each monitoring effort or environmental study, the QA Program Plan requires a QA Project Plan that establishes the needed level of data quality and how it will be obtained before the data gathering begins. The DHES developed QA Project Plans that cover the collection and analysis of water and wastewater samples for the Intensive Survey, MPDES Compliance Monitoring and Drinking Water Programs and the lower Clark Fork River Monitoring Project. These plans were implemented in June 1984, along with a preliminary Field Procedures Manual that established Standard Operating Procedures for specific monitoring and field measurements performed by the DHES.

A four-day Quality Assurance Workshop held during June 1985 at EPA Region VIII Headquarters in Denver was attended by the state QA coordinator. The Region VIII QA Office presented information on EPA QA requirements, and representatives from the region's state programs participated in panel discussions aimed at resolving common problems

An on-site evaluation of the DHES QA program was conducted by the EPA Region VIII QA Officer in September 1985. No major problems or deficiencies were identified in the internal (laboratory) QA procedures for water analyses. It was recommended that DHES submit blind spikes of sample water (e.g., known quantities of chemicals added to stream water) to the laboratory as part of its field QA procedures. Also recommended were revisions to the state's Field Procedures Manual and Drinking Water QA Plan, and development of QA Project Plans for biological monitoring and ground water monitoring for the Underground Storage Tank Program. The Drinking Water QA Plan has been revised and approved by EPA. The remainder of the recommendations are currently being implemented or will be completed in 1986.

6.4.11. DATA MANAGEMENT

The DHES maintains a computer file of nearly all water samples analyzed by the department's Laboratory Division since 1973. As of January 1986, the file contains chemical, physical and other data on approximately 28,800 water samples. In addition, the file includes a small portion of our biological data. Approximately 15,800 of these water samples are from natural surface waters in Montana. Of the remaining 13,000, about 6,000 are from public water supplies and the remaining 7,000 are from other wells and springs, wastewater discharges and other miscellaneous sources.

Of the 15,800 water samples from natural surface waters, about 15,240 have been entered into EPA's STORET system. The remainder (about 560) have not been entered for various reasons, the most common one being lack of a specific sampling site location.

A recent project regrouped DHES sampling sites into a new set of stations, and used a new scheme for identifying stations on STORET. This required a look at the location data for each natural surface water sample. From October through December 1985, all of the station and the parameter data were deleted from STORET, the new station data entered, then all of parameter data reloaded. One immediate benefit was a reduction in the number of stations from nearly 4,000 to about 2,680.

The new station identifier consists of eight characters which are derived as follows:

Example: 3526CL01 (Clark Fork R. above Deer Lodge,

township = 07N, range = 09W)

Characters 1-2: a two-digit number derived from the township for the station and equals:

28 + township number, if a north township

28 - township number, if a south township.

Characters 3-4: a two-digit number derived from the range for the station and equals:

35 + range number, if an east range

35 - range number, if a west range

Characters 5-6: the first two characters of the stream or lake name.

Characters 7-8: a two-digit sequential number starting at 01 which makes the station identifier unique in cases where duplication of the first six characters occurs

Quality assurance of the data has been improved by more thorough checking of the reported laboratory results immediately after keypunching the data. This checking is done by laboratory personnel. Also, the procedure for handling corrections has been improved, and now results in a new data report being produced so that laboratory personnel can verify the corrections

The data management system can still be improved Computerization of biological data has been in the planning stage for a number of years, but little progress has been made to develop a system The current method for maintaining station files and for putting station identifiers on water sample records remains cumbersome. Development of an on-line data entry system, which would reduce costs and delays associated with batch keypunching, would be beneficial. Such a system with some enhancements could provide many other benefits to laboratory personnel, as well as pollution control personnel Improved data retrieval programs, including better use of STORET features, should be implemented with a special emphasis on graphic display of data.

A personal computer based system would appear to provide a rapid, inexpensive means of improving our data management However there are concerns about such a system, the major one being the speed (response time) of data entry and retrieval A personal computer based software system (obtained from the State of Alaska) for managing data associated with the Public Water Supply Program recently became operational Experience gained from this system will help determine whether a similar system would be beneficial for managing more water quality information.

6.5. SPECIAL PROGRAMS

6.5.1. FLATHEAD BASIN COMMISSION

The five-year Flathead River Basin Environmental Impact Study funded by the EPA and completed in 1983, left no doubt that water quality in the Flathead River Basin is deteriorating at an accelerating

rate. Slowing this transformation requires pinpointing pollution sources, weighing the trade-offs involved in ending pollution and coordinating the many agencies that share jurisdiction over important development-related decisions in the basin

In response to public support, the 1983 Montana Legislature established the Flathead Basin Commission to "protect the existing high quality of the Flathead Lake aquatic environment; the waters that flow into, out of, or are tributary to the lake; and the natural resources and environment of the Flathead basin."

The commission is comprised of members from federal, state, local and tribal agencies, as well as private interests, and is charged with: 1) monitoring the basin's natural resources, 2) encouraging cooperation among basin land managers, 3) holding public hearings on the condition of the basin, 4) supporting economic development without compromising the basin's aquatic system, 5) promoting cooperation between Montana and British Columbia on resource development in the Flathead basin and 6) making recommendations to the legislature regarding the preservation of the basin's aquatic resources.

To meet its challenges, the commission calls on technical experts and land managers from state, federal, tribal, and local agencies and scientists from the university system. Examples of recent actions by the commission include its successful lobbying effort for legislation that allows local governments to restrict the sale and distribution of phosphate detergents (Chapter 75, Title 7, Section 401 et seq. MCA), and its recommendation to the state's DHES to require phosphorus removal at municipal wastewater treatment plants discharging to Flathead Lake or its tributaries.

The commission has also been instrumental in establishing and seeking funding for a Water Quality Monitoring master plan in the basin, the first of its kind. This Master Plan integrates water quality monitoring by area agencies, the Montana university system, and private land owners. It will provide a comprehensive assessment of changes in water quality, as well as identify the probable reasons for any changes

The commission is required to submit a biennial report to the governor and the appropriate committees of the legislature, and to make recommendations appropriate for fulfillment of its duties. The first biennial report was issued in October, 1985. Through a discussion of the many issues in the report, the commission emphasized the need to coordinate agency regulations regarding water quality, and for all regulatory parties to interact frequently. The report also noted that citizens should be allowed to question agency officials who sit on the commission about the agency's use of authority in water quality-related decisions. The commission, by means of public meetings and hearings, actively pursues and solicits public opinion regarding Flathead Lake and the quality of water in the basin.

Water quality monitoring and adequate funding to implement the Master Plan continue to be the first priorities. The commission is active in supporting agency budget requests for water quality monitoring

programs, as well as exploring other sources of funding for these activities

The Freshwater Foundation is a Minnesota based, non-profit organization which has supported fresh water research and public information programs since 1968. The commission recently began working with the Freshwater Foundation to develop an integrated public education program regarding the water quality problems facing Flathead Lake and other water bodies in the basin. The Flathead Basin Commission and the Freshwater Foundation recognize that the water problems facing the Flathead are social, economic and political in nature Now that the key parameters of the basin's problems have been scientifically described, the implementation of solutions is the next step Such implementation will require enhanced public understanding of the problem if it is to be accepted. Using Freshwater Foundation support, the commission plans to hire a program manager whose duties would include assisting in the development of a speakers bureau, slide shows, breakfast meetings and a 1986 water quality seminar regarding the relationship between clean water and the health of the local economy

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6.5.2. FLATHEAD LAKE PHOSPHORUS STRATEGY

Mounting concern over the accelerating eutrophication of Flathead Lake (see Section 5.1.) and resource and recreational development in the Flathead Basin have prompted government action on many fronts to forestall water quality degradation. (See also sections 6.4.2 and 6.5.1.)

In April 1984, the DHES prepared a Strategy for Limiting Phosphorus in Flathead Lake. The strategy outlined a six-point plan to reduce incoming phosphorus to the lake:

1. Impose a phosphorus limit of 1 mg/l on all state-permitted effluents in the basin;

2. Develop wastewater management plans for unsewered communities in the basin;

3. Recommend legislation to allow the sale of only low or phosphorus-free laundry detergents;

4. Strengthen the control of non-point sources of phosphorus;

5. Require subdividers to evaluate the phosphorus-adsorption capacity of soils where drainfields would be sited near surface water, and

6 Expand and refine the phosphorus monitoring program in the basin

This approach does not single out any one source of phosphorus, but applies controls to all controllable sources. Not only is this approach equitable and fair, scientists are convinced it is necessary in order to make any headway against accelerating eutrophication.

After two years there is some very real progress to report in all six areas of the strategy:

1. Phosphorus limits have been placed on treated wastewater effluents discharged by the communities of Big Fork, Columbia Falls, Kalispell and Whitefish, and compliance schedules have been approved for each community. The federally funded Construction Grants Program will help pay the cost of necessary improvements to wastewater treatment plants. (The treatment plants at Hungry Horse Dam and at the UM Biological Station, which serves Yellow Bay State Park, are already meeting their phosphorus limits.)

2. Progress is being made toward eliminating local water quality problems at Lakeside and in the Whitefish County Water and Sewer District surrounding Whitefish Lake. Both areas are unsewered. (See Section 3.1.2.)

3. The 1985 Legislature passed HB 711, which allows counties to adopt an ordinance to restrict the distribution and sale of phosphorus-containing detergents. Implementation of such an ordinance will reduce the amount of phosphorus entering municipal wastewater treatment plants, reduce treatment costs and, more importantly, reduce the amount of phosphorus that originates from the other half of the basin's population that uses on-site sewage disposal.

4. The Flathead National Forest has completed a 10-year Forest Plan and draft EIS that addresses the water quality implications of resource management alternatives. Region One of the U.S. Forest Service, which includes the Flathead National Forest, has strengthened its management practices to protect water quality.

5. In December 1984, the Montana Water Quality Standards were amended to allow closer review by the DHES of sewage systems in subdivisions that might be impacting lakes and streams. If necessary, the state may impose additional treatment to curtail the off-site transport of phosphorus.

6. The Flathead Basin Commission has coordinated the design and funding of a comprehensive monitoring plan. Approximately $86,000 per year have been committed from a variety of government and private sources to continue phosphorus and related water quality monitoring in the basin. (See Section 6.4.2.)

The DHES has prepared a more comprehensive assessment of progress made under the phosphorus strategy.*

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* DHES. November 1985. Update: strategy for limiting phosphorus in Flathead Lake. Water Quality Bureau, Helena.

Controlling incoming phosphorus to Flathead Lake will help, but phosphorus is not the only factor that regulates algae growth and the lake's trophic status. Flathead Lake is a complex ecosystem that responds to a myriad of physical and biological influences. Manipulation of the lake level by Kerr Dam and releases from Hungry Horse Dam upstream are affecting the ecology of Flathead lake in ways that scientists are only beginning to understand. Introduced species like yellow perch, kokanee salmon and the opossum shrimp (Mysis relicta) may be promoting algae blooms by selectively feeding on the larger microcrustaceans that would ordinarily graze the algae and keep them in check.

In the summer of 1986, scientists from both sides of the International Boundary (including two from the DHES) will wrap-up their assessments of water quality impacts attributable to the proposed Sage Creek open pit coal mine just north of the border in the North Fork Flathead River Drainage of British Columbia. One possible effect will be an increase in the export of phosphorus to Flathead Lake. This effort will culminate nearly two years of work under the auspices of the International Joint Commission to resolve concerns expressed by citizens and by the governments of Montana and the United States regarding the environmental effects of the proposed mine on the Flathead Lake/River ecosystem.

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6.5.3. CLARK FORK RIVER BASIN PROJECT

The Clark Fork River is a key resource for western Montana. Arising near the west central mining communities of Butte and Anaconda, the river drains nearly 20,000 square miles before entering Idaho and Lake Pend Oreille. Throughout this large river basin, there is a high degree of public concern for water quality issues, and a strong desire to maintain and enhance the river's resource potential.

The scientific community, concerned agencies and citizens have responded to these concerns by recently initiating more than 30 pollution-related investigations and clean up activities involving the Clark Fork. These range from Superfund investigations on the river's headwaters area near Butte to limnological studies in Idaho's Lake Pend Oreille. In 1984, a project was initiated within the Governor's Office to coordinate these activities and to identify where additional

information is most urgently needed if the health of the Clark Fork is to be improved.

The principal objective of the Clark Fork Project is to provide administrative continuity to past, current and planned water-related studies within the basin and to identify where additional information is most urgently needed. The project will coordinate findings from studies associated with pulp mill and municipal discharges, and evaluate mining permits, water reservation applications, Superfund projects, abandoned mine land reclamation projects, water quality and water flow stations and other monitoring activities being conducted by governmental agencies, industry or by units of the Montana university system. The coordination will minimize duplication and efficiently use budgets allocated for agency water studies. Technical guidance for the project is provided by an interagency and interstate task force of state, federal and university scientists. Project direction is provided by state natural resource agency directors, the Environmental Quality Council and a citizen's advisory committee.

The project's final document will include a comprehensive data base for the river, will identify major water-related problems within the basin and will provide a framework for their resolution. The report will provide state, federal and local decision makers with an array of water quality management choices.

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6.6. COST/BENEFIT ASSESSMENT

A strict monetary assessment of costs and benefits that accrue from pollution control activities is necessarily restricted to instances where reliable data are available both on the value of unpolluted water and on the expense of maintaining or restoring water quality. In Montana, estimates of pollution control costs are more common and much easier to obtain than estimates of resource value. In only one instance--the Flathead River/Lake system--do we have reasonably reliable but not necessarily comprehensive estimates for both.

The Flathead River and Flathead Lake together provide a major focus for recreational activities within the Flathead Basin. The forks of the Flathead, as well as a portion of the mainstem, are designated components of the National Wild and Scenic River System. Flathead Lake, with its 126,000 surface acres, is the largest natural freshwater lake in the West. The entire system is known for its high quality, but recent signs of accelerating eutrophication in the lake have prompted the Department of Health and Environmental Sciences (DHES) to propose extraordinary steps to safeguard this valued resource. (See Section 6.5.2. Flathead Lake Phosphorus Strategy and Section 5.1. Eutrophication of Flathead Lake.)

Among these steps the DHES has imposed phosphorus limits on all state-permitted effluents in the Flathead Lake drainage. Meeting these phosphorus limits, plus additional limits placed on the City of Kalispell wastewater discharge to meet water quality standards in Ashley Creek, will require considerable investment in advanced wastewater treatment technology by the four municipalities affected: Kalispell, Columbia Falls, Whitefish and Bigfork. The annual capital and operation and maintenance costs for advanced wastewater treatment at these four cities is about $443,000 per year * An expanded and refined water quality monitoring program, another point in the phosphorus strategy, will cost an additional $87,000 per year.** Hence the total cost of implementing these two initial steps of the DHES phosphorus strategy is about $530,000 per year. The annual cost of implementing the four remaining steps in the DHES phosphorus strategy is unknown. Ultimately, additional steps may be required to slow down the eutrophication of Flathead Lake. But relatively small steps taken now may preclude the need for much more costly measures to restore degraded water quality later on.

The preservation value of an unpolluted Flathead River/Lake system has been estimated to be about $82 million per year.*** The total recreational use value of this system is estimated to be an additional $5 million per year **** The value of clean Flathead River and Lake water to other users is unknown. Certainly some degradation of water quality would not preclude these uses entirely, but the value of the resource would be diminished substantially. The Flathead River/Lake system is one of the few remaining relatively unspoiled major aquatic ecosystems in the country and draws visitors from all over the world. If its reputation became tarnished by algae blooms, it would no longer be a drawing card and would forfeit much of its value.

The cost and benefits (both social and economic) of achieving the goals of the Clean Water Act in Montana are unknown. The environmental consequences of not achieving the fishable/swimmable goals of the Act have been discussed elsewhere in this report. (See sections 3.1.2. and 3.3.)

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* Source: Water Quality Bureau memo on status of Flathead River Basin Projects, February 28, 1985. Revised April 21, 1986

** Source: "Monitoring Surface Water Quality in the Flathead Basin: Master Plan." Open File Report, Flathead Lake Biological Station, Bigfork.

*** Sutherland, R.J. and R.G. Walsh. 1985. Effect of distance on the preservation value of water quality. Land Economics, Vol. 61, No. 3

**** Sutherland, R.J. 1982. Recreation and preservation estimates for Flathead River and Lake system. Flathead River Basin Environmental Impact Study Final Report. June 30, 1983. U.S. Environmental Protection Agency.

7. Recommendations

The greatest limitation in addressing nonpoint source water quality problems is lack of funding for implementation. The USDA cost-share programs do not focus on water quality improvement as their primary goal, and do not offer sufficient incentives for widespread implementation of conservation practices that benefit water quality. The federal land management agencies are facing directives that emphasize resource development and commodity production, while at the same time suffering budget cutbacks for water quality monitoring and watershed rehabilitation. There is a need for increased resources to devote toward monitoring and assessment of nonpoint problems. Many of the sedimentation problems which are pervasive throughout the state are not well characterized and documented. An increased emphasis upon biological monitoring is warranted to better assess the impacts of sedimentation and the effects of multiple pollutants on beneficial uses. Resources are also needed: to better evaluate the effectiveness of management practices which are implemented; to assess whether BMP implementation is taking place; and to support a staff which continues the visibility and concern for maintaining water quality.

A consistent and adequate source of federal funds in the Construction Grants Program is necessary to achieve the objectives of the Clean Water Act. Failure of Congress to reauthorize the act and provide realistic appropriations has already adversely affected necessary construction projects in Montana. Any phasing out of the Construction Grants Program should occur gradually over a number of years to allow completion of unfinished projects as well as providing new grants for high priority projects.

The many new complex treatment plants now being built with construction grants money will demand a number of adequately trained operators. Non-complying facilities will no longer be able to rely on federal funds and major capital improvements as an answer to unacceptable treatment performance. Improved operational controls and adequately funded replacement/depreciation/maintenance programs will become the mainstays for compliance by municipal wastewater treatment facilities.

APPENDIX

STREAM SEGMENT INFORMATION

The geography that restricts water to certain courses is commonly called a drainage basin. Much of the information in this report refers to these geographically distinct areas.

The three major basins -- the Clark Fork, Missouri and Yellowstone -- are so large and diverse they have been divided into parts.

Montana's sixteen principal river basins are a convenient way to organize stream water quality problems. For each basin we present 1) a brief narrative description of physical features and natural water quality, 2) a list of apparent and potential problem stream segments with the probable impaired uses and the severity index and problem parameters for each impaired use and 3) a map showing principal towns and water bodies plus the location of each problem segment. The following is an explanation of the abbreviations used in the basin lists of apparent and potential problem segments:

Impaired Uses

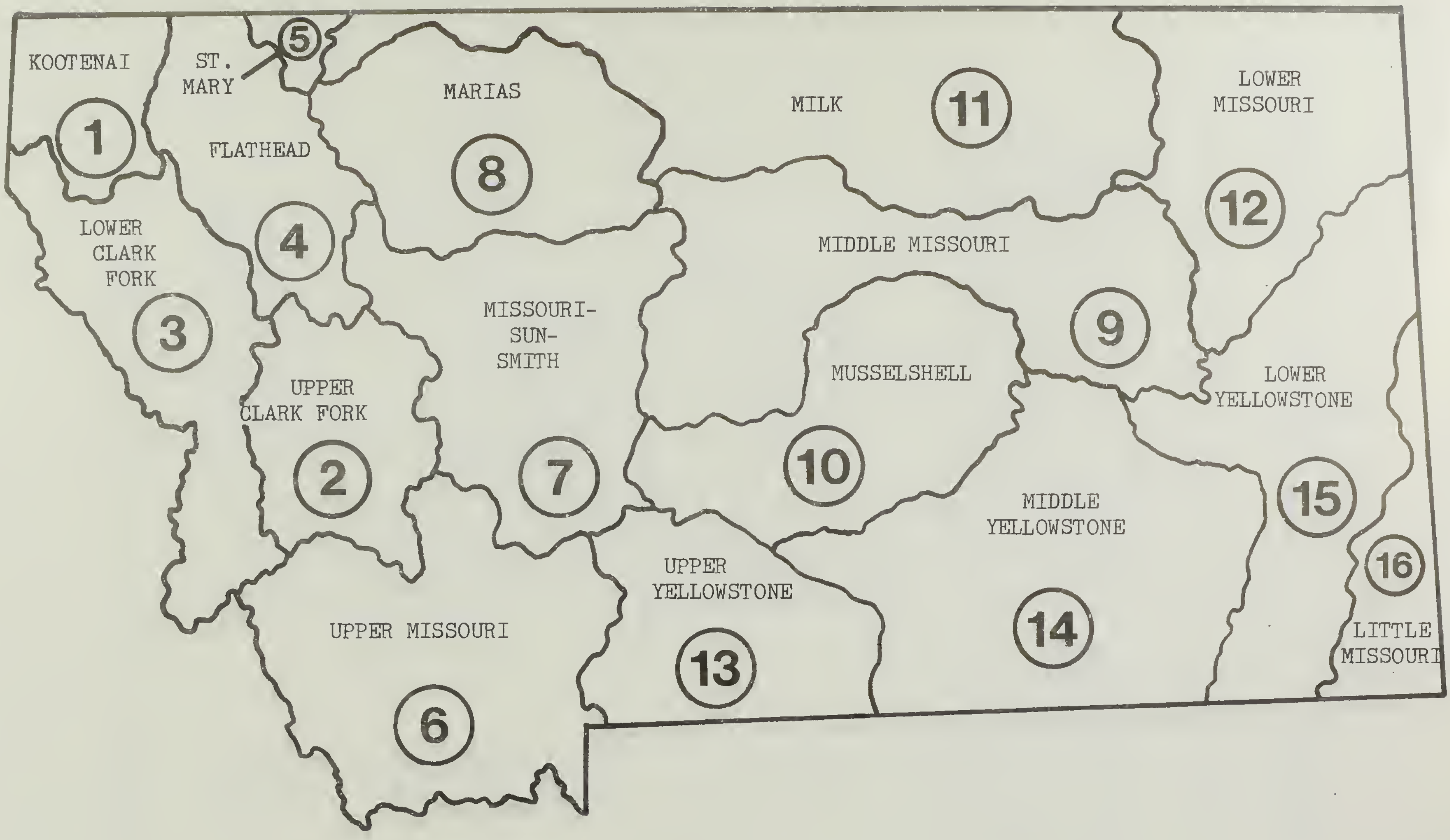
A(C)	Aquatic life (cold water)
A(W)	Aquatic life (warm water)
P	Public water supply
R	Primary contact recreation
I	Irrigation
L	Livestock watering

Problem Parameters

Ammonia	Total ammonia (NH_3 + NH_4)
BOD	Biochemical oxygen demand
DO	Dissolved oxygen
FC	Fecal coliforms (bacteria)
Gases	Dissolved gases
Metals	Copper, cadmium, zinc, etc.
N	Nitrogen, total
NH_3	Un-ionized ammonia
NO_3	Nitrate
NO_2	Nitrite
P	Phosphorus, total
pH	pH too low or too high
SO_4	Sulfate
*TDS	Total dissolved solids (salinity)
Temp	Temperature (too high)
**TSS	Total suspended solids (sediment)

* Exceedence of TDS and/or conductivity criterion

** Exceedence of TSS and/or turbidity criterion



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1 - KOOTENAI RIVER BASIN

The Kootenai River Basin is a well-watered region of steep, heavily timbered mountains and narrow valleys. The area is sparsely inhabited and contains few industries and communities. Timber harvest, mining and tourism are the primary commercial activities. Agriculture is a relatively minor pursuit in the basin.

A major hydroelectric installation -- Libby Dam -- has turned a good share of the once free-flowing Kootenai River into slack water. Other hydroelectric developments on the Kootenai are contemplated, and a major copper and silver mining and milling facility is in operation near Troy.

Precipitation in the basin is about 24 inches per year in the valleys to more than 80 inches a year in the mountains. Elevations range from nearly 9,000 feet in the Cabinet Mountains to about 1,800 feet near Troy, the lowest point in Montana.

Forest soils present a moderate to severe erosion hazard. Commercially attractive copper, silver and vermiculite deposits have prompted exploration and mining. Roadless and wilderness areas attract increasing numbers of visitors each year

The Kootenai River Basin includes some of the purest waters in America; concentrations of dissolved chemicals are among the lowest in Montana. Streams are significantly less productive and potentially more sensitive to acid mine drainage and heavy metals pollution than streams elsewhere in Montana.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Fisher R.	Kootenai R	A (C)	0 24	Temp
2	Snowshoe Cr.	Big Cherry Cr.	A (C)	9.32	Zinc
3	Stanley Cr.	Lake Cr	A (C)	*	TSS, Copper

* Excursions from criteria for TSS and copper have been documented using data that are not on STORET


Eureka
Lake Koocanusa
River
Yaak
Troy
KOOTENAI
RIVER
Libby
River
Fisher
1
2
3
N
KOOTENAI RIVER BASIN
0
10
20
Miles

2 - UPPER CLARK FORK RIVER BASIN

The upper Clark Fork River Basin contains moderately timbered and highly mineralized mountain ranges separated by broad agricultural valleys.

Elevations in the drainage range from over 10,000 feet in the Anaconda Range to slightly more than 3,000 feet near Missoula. Total precipitation generally increases with elevation, with more snowfall in the mounteins. Valley precipitation varies from 8 to 20 inches annually, most of it falling in the late spring and early summer.

The basin comprises an area of 6,115 square miles or nearly four million acres. Forests cover 2.3 million acres, pasture and range 880,000 acres, urban and built-up areas 54,000 acres and lakes and impoundments 9,700 acres. Irrigated cropland covers 150,000 acres of the basin and dry cropland exceeds 23,000 acres. Irrigated agriculture accounts for the largest use of water in the basin; total diversion requirements for irrigation approach 500,000 acre-feet per year with a net depletion of nearly one-half that amount.

Water quality varies considerably within the basin. Silver Bow Creek below Butte has some of the worst water quality in the state, while Rock Creek near Missoula is considered by many as a "blue ribbon" trout fishery. Pristine, nearly sterile, high mountain lakes dot some of the higher mountain ranges in the basin, while eutrophic Georgetown Lake near Anaconda is one of the most productive fisheries in Montana.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Beartrap Cr. below Mike Horse Dam and Adit	Blackfoot R.	A (C)	2.56	Iron, Zinc, Cadmium
			P	67 58	Manganese
2	Blackfoot R. above Lincoln	Clark Fork R.	A (C)	1.93	Zinc, Cadmium
			P	9.07	Manganese
3	Clark Fork R., Warm Springs Cr. to Little Blackfoot R.	Pend Oreille R	A (C)	0 25	TSS, P, Iron, Copper, pH, Temp
			P	2.59	Manganese, Lead, pH
			R	1 39	P, pH
			I	0.63	pH
4	Clark Fork R., Little Blackfoot R. to Blackfoot R.	Pend Oreille R	A (C)	0.55	TSS, Temp, P, Copper, Iron, pH
			P	0 26	Lead, Manganese, pH
			R	0.05	P, pH
5	Douglas Cr. at Philipsburg	Flint Cr	P	2.60	Arsenic
			I	1.30	Arsenic
6	Elk Cr.	Blackfoot R	A (C)	2.07	TSS

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
7	Flint Cr.	Clark Fork R	A (C)	0.12	TSS
			P	0.50	Manganese
8	Little Blackfoot R.	Clark Fork R.	A (C)	1.50	P
9	Mike Horse Cr. below Mike Horse Mine Adit	Beartrap Cr.	A (C)	6.76	Iron, Zinc, Cadmium
			P	26.66	Manganese, SO_4, Zinc, Cadmium
			I	1.19	Zinc
10	Mill-Willow Bypass	Silver Bow Cr.	A (C)	0.93	Iron, Copper
			P	1.13	Manganese, SO_4
11	Silver Bow Cr. above Warm Springs Ponds	Clark Fork R.	A (C)	5.12	TSS, P, Copper, Iron, Zinc
			P	0.18	Copper, Lead
			R	9.40	P
			L	0.04	Copper
12	Silver Bow Cr. below Warm Springs Ponds	Clark Fork R.	A (C)	0.95	pH, Temp, P
			P	1.13	pH, Manganese
			R	1.38	pH, P
			I	0.20	pH
13	Warm Springs Cr. below Anaconda	Clark Fork R	A (C)	0.14	TSS, Temp, pH, Copper
			P	0.04	pH, SO_4
			R	0.09	pH


River
Blackfoot
Bonner
Clark
Fork
River
Deer Lodge
Clark Fork R.
Anaconda
Butte
N
UPPER CLARK FORK RIVER BASIN
0
10
20
30
40
Miles
1
2
3
4
5
6
7
8
9
10
11
12
13

3 - LOWER CLARK FORK RIVER BASIN

The lower Clark Fork River Basin, along the western border of Montana, comprises an area of 8,900 square miles or over 5.5 million acres. This basin includes 1,900 square miles of the Flathead River drainage below Flathead Lake, 2,800 square miles in the Bitterroot River drainage and all of the Clark Fork River drainage below the Blackfoot River.

About 60 percent of the basin is in federal ownership, mostly national forest land. Cropland covers about 400,000 acres, two-thirds of which is irrigated. Principal industries in the basin are agriculture, tourism, logging and forest products Rich copper and silver deposits on the south end of the Cabinet Mountains have been intensely explored in recent years.

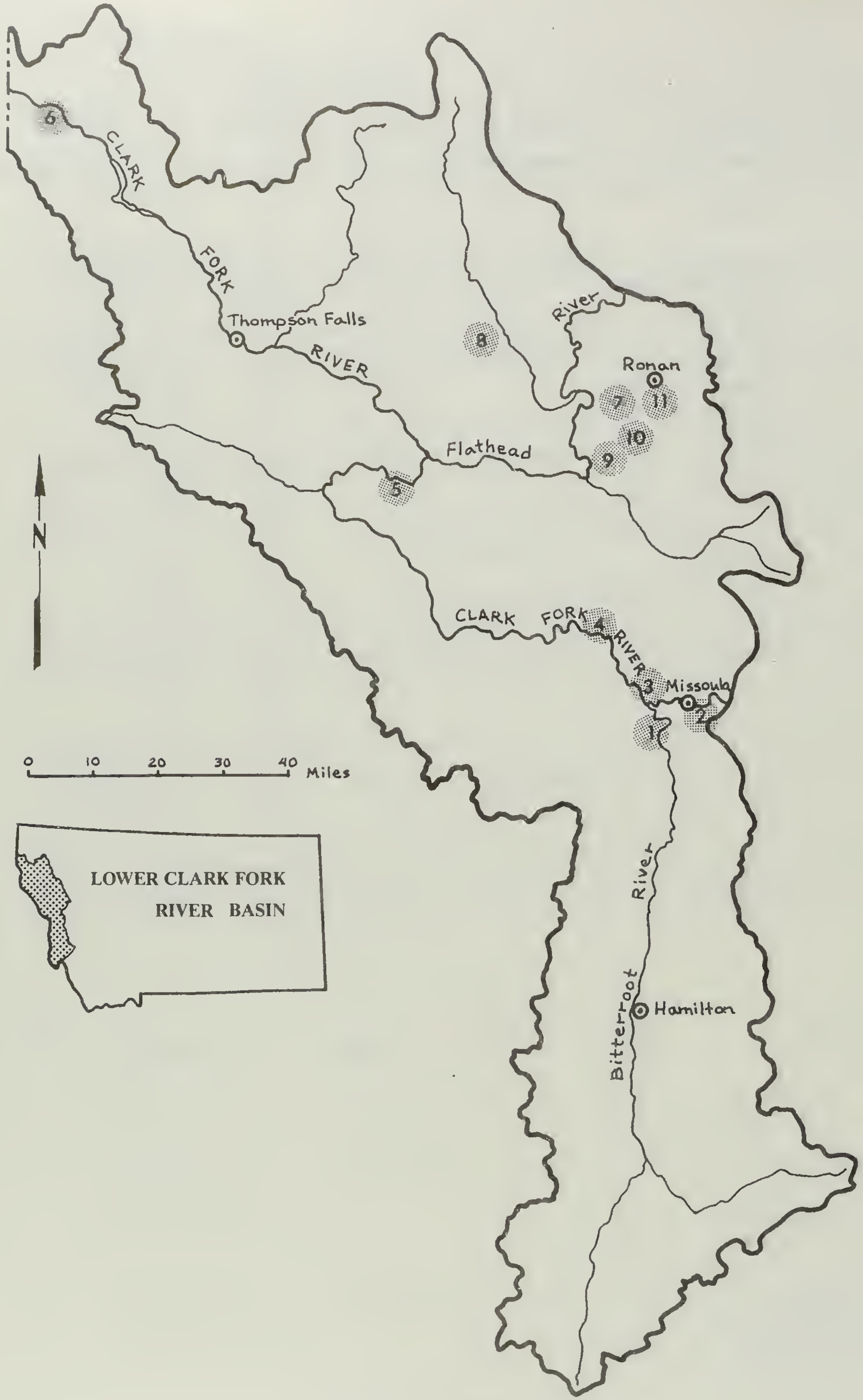
The climate in the lower Clark Fork River Basin is variable, depending on elevation. Annual precipitation ranges from less than 10 inches southwest of Flathead Lake to more than 40 inches in the higher mountains. Elevations in the basin range from more than 10,000 feet in the Bitterroot Range to about 2,000 feet where the Clark Fork River enters Idaho.

Although it accounts for only about 15 percent of the land area, agriculture is by far the largest water user in the basin. Annual diversion requirements for irrigation approach 1.6 million acre-feet of water with a net depletion of 760,000 acre-feet per year.

Water quality is variable. Generally, rivers and streams flowing through concentrated agricultural areas are degraded, with temperatures, dissolved solids and other variables indicating the effects of irrigation diversions and return flows. Municipal and industrial effects are present but subdued. Streams flowing through remote areas have excellent water quality tempered only by the effects of seasonal runoff. Water entering the basin near Missoula still retains some effects of municipal and industrial waste discharges far upstream in the Butte-Anaconda-Deer Lodge area.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Bitterroot R.	Clark Fork R	A (C)	0 23	TSS, Temp, Iron
			P	0.01	Manganese
2	Clark Fork R., Blackfoot R. to Missoula WWTP	Pend Oreille R.	A (C)	0.24	Iron, Copper, P, TSS, Temp, pH
			P	0.68	Manganese, pH
			R	0.30	P, pH
3	Clark Fork R., Missoula WWTP to Champion International	Pend Oreille R.	A (C)	0.93	P, Iron, Copper, NH_3, TSS, N, pH, Temp
			P	1.62	pH, Manganese, Ammonia
			R	2.49	P, FC, pH

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
4	Clark Fork R., Champion International to Huson	Pend Oreille R	A (C)	0.38	TSS, Iron, pH, DO, Temp
			P	0.48	Manganese, pH
			R	0.09	pH
5	Clark Fork R., Huson to Flathead R.	Pend Oreille R.	A (C)	0.33	TSS, Temp, Iron, pH
			P	0.29	pH, Manganese
			R	0.31	pH
6	Clark Fork R., Flathead R. to below Cabinet Gorge Dam	Pend Oreille R.	A (C)	0.43	DO, TSS, Temp, Iron, pH
			P	0.06	pH, Manganese
			R	0.06	pH
7	Crow Creek	Flathead R.	A (C)	0.52	TSS, N, P, Temp
			R	1.29	FC, P
			I	0.18	FC
8	Hot Springs Cr. below Hot Springs WWTP	Little Bitterroot River	A (W)	3.13	N, P
			P	2.12	Ammonia
			R	4.92	P
9	Mission Cr.	Flathead R.	A (C)	0.55	TSS, N, P, Temp
			P	0.03	Ammonia
			R	2.19	FC, P
			I	0.30	FC
10	Post Cr.	Mission Cr.	A (C)	0.34	TSS, N, P
			R	1.76	FC, P, pH
			I	0.21	FC
11	Spring Cr. below Ronan	Crow Cr.	A (C)	2.14	N, P
			R	6.88	FC, P
			I	1.65	FC



CLARK
FORK
Thompson Falls
RIVER
River
Ronan
Flathead
N
CLARK FORK
RIVER
Missoula
0 10 20 30 40 Miles
LOWER CLARK FORK
RIVER BASIN
River
Bitterroot
Hamilton
1
2
3
4
5
6
7
8
9
10
11

4 - FLATHEAD RIVER BASIN

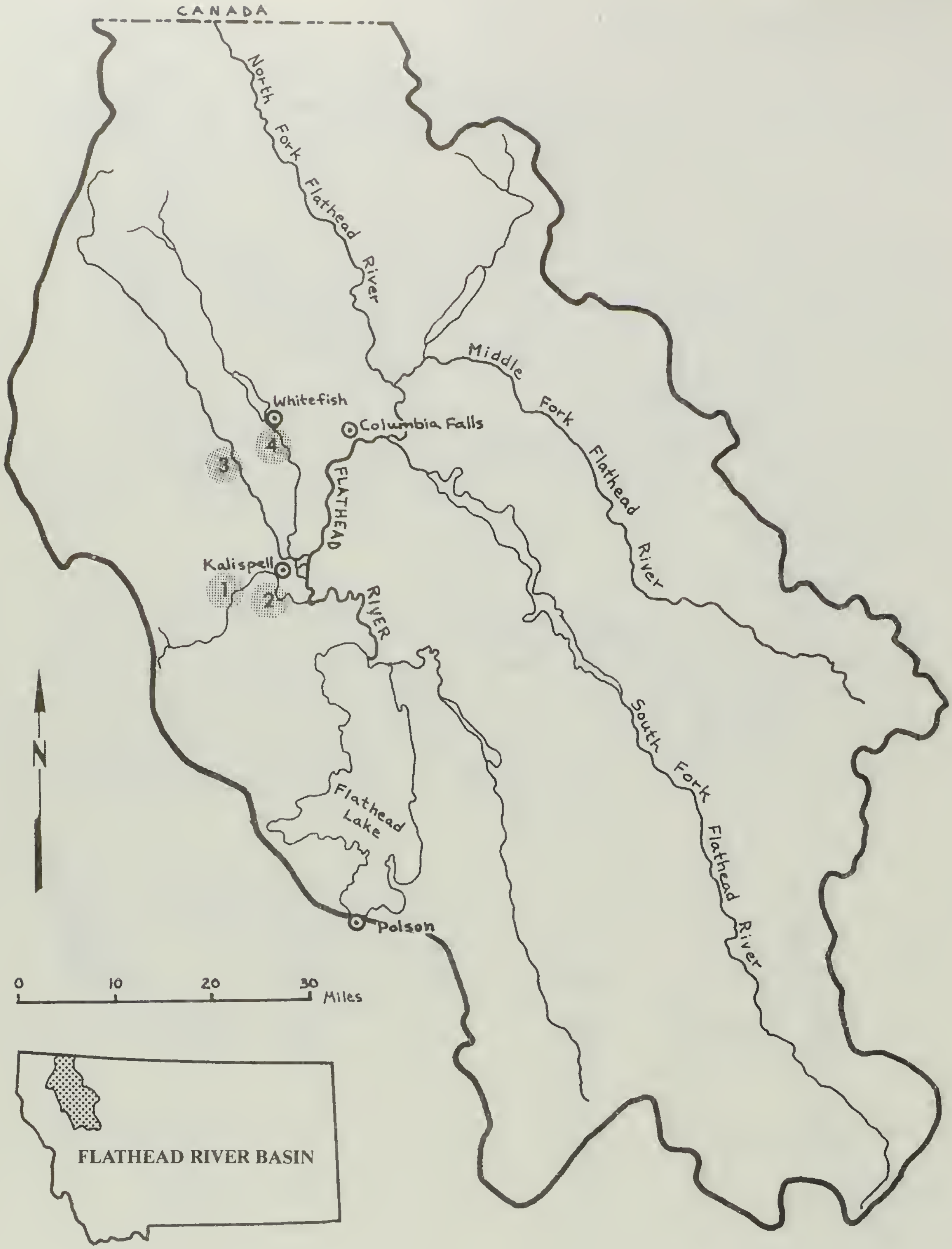
The Flathead River Basin drains much of northwestern Montana It extends south from the Canadian border, west from the Continental Divide, north from the lower end of Flathead Lake and east from the Whitefish and Salish mountains

The region is largely mountainous and forested, with timber harvest the principal industry and agriculture restricted to the most narrow valley bottoms The one notable exception is the broad north-south trough that contains Flathead Lake and the agricultural/commercial heart of the basin: the Flathead Valley. Most of the basin is sparsely inhabited except for the area around Kalispell, which is at the center of one of the fastest growing regions of Montana.

Elevations in the drainage range from more than 10,000 feet in Glacier National Park to about 2,900 feet on Flathead Lake. The climate is moist and cool, influenced both by Pacific weather systems from the west and by the stabilizing effect of the 183 square mile Flathead Lake. Annual precipitation varies from over 50 inches in the mountains to about 20 inches in the Flathead Valley.

As a headwater drainage of the Clark Fork-Columbia River system, the Flathead has some of the purest waters in America. With few exceptions, waters in the basin are suitable for all beneficial uses following minimal treatment. Water quality problems are usually associated with surface disturbances, concentrations of livestock or people, and with large hydroelectric dams. Forestry and agriculture are the primary land-disturbing activities. Canadian coal development across the border in British Columbia portends water quality impacts on the North Fork of the Flathead River.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Ashley Cr. above Kalispell WWTP	Flathead R.	A (C)	0.42	Temp, pH
			P	0 51	pH
			R	0.51	pH
2	Ashley Cr. below Kalispell WWTP	Flathead R.	A (C)	4.65	NH_3, TSS, Temp, DO, N, P
			R	11.24	P, FC
			P	3 62	Ammonia
			I	1.96	FC
3	Stillwater R. below Logan Cr.	Flathead R.	A (C)	0.45	TSS, Temp, P
			R	0 57	P
4	Whitefish R. below Whitefish Lake	Stillwater R.	A (C)	0.52	TSS, Temp, NH_3, P
			R	0 93	P



CANADA
North Fork Flathead River
Middle Fork Flathead River
South Fork Flathead River
Whitefish
Columbia Falls
FLATHEAD RIVER
Kalispell
Flathead Lake
Polson
1
2
3
4
N
0
10
20
30
Miles
FLATHEAD RIVER BASIN

5 - ST. MARY RIVER BASIN

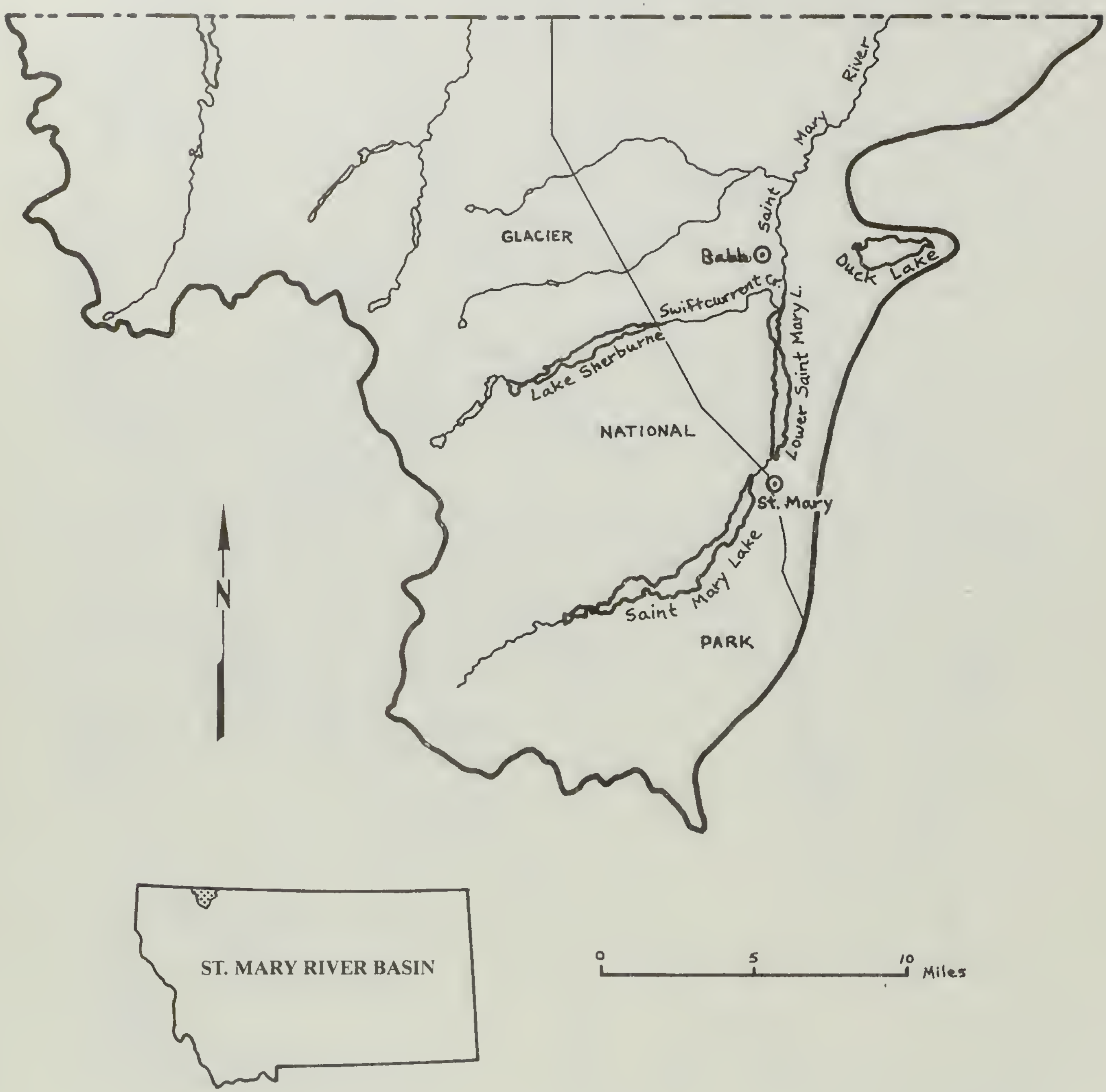
The St. Mary River Basin is less than one percent of the total land area in Montana. Seventy percent of the basin is in Glacier National Park and 30 percent on the Blackfeet Indian Reservation. The waters form the headwaters of Canada's Saskatchewan River system, which drains north and east to Hudson's Bay. Physical characteristics in the basin include the spectacular mountains, glaciers and glacial lakes in Glacier Park, forested hill terrain at lower elevations, and rolling rangeland in the St. Mary River Valley. Elevations in the drainage range from more than 10,000 feet in Glacier National Park to less than 4,500 feet at the international border. Climate is dependent on elevation. Rainfall varies from 120 inches a year in the mountains to 20 inches a year on the prairie. Temperature extremes are generally more pronounced at lower elevations, particularly under the influence of chinook winds in the winter.

The quality of waters in the St. Mary drainage basin is generally excellent. Population in the basin is sparse, and wastewater discharges few and minor. The primary land use outside Glacier Park is grazing and only a small fraction of the drainage is farmed. The two principal stream segments in the basin are the Belly and the St. Mary rivers.

The Belly River drainage in Montana is confined entirely to Glacier National Park. All waters in the drainage are nearly pristine, and suitable for most beneficial uses with little or no treatment.

The St. Mary River and its tributaries are classified as being drinkable after conventional treatment. Swiftcurrent Creek is seasonally dewatered and has been subject to hydrologic damage.

The post-1975 data available to the Water Quality Bureau on STORET indicate that there are no significant pollution problems in this basin that are predominantly man-caused.


Saint Mary River
GLACIER
Babb
Duck Lake
Swiftcurrent Cr.
Lower Saint Mary L.
Lake Sherburne
NATIONAL
St. Mary
Saint Mary Lake
PARK
N
ST. MARY RIVER BASIN
0
5
10
Miles

6 - UPPER MISSOURI RIVER BASIN

The upper Missouri Basin, which includes southwestern Montana and northwestern Yellowstone National Park, is characterized by several large mountain ranges separated by broad agricultural valleys with extensive irrigation development The basin is drained by the Gallatin, Madison and Jefferson rivers, which form the Missouri River near the town of Three Forks. These and other streams in the drainage are some of the most popular and productive cold-water fisheries in America.

Population in the basin is sparse and strongly tied to agriculture. However, aesthetic qualities have resulted in increased tourist trade and recreation-based industries, thus attracting new residents

Elevations in the drainage range from over 11,000 feet in several of the mountain ranges to less than 4,500 feet at Three Forks Valley precipitation is about 12 to 20 inches per year. Peak precipitation occurs in May and June followed by a lesser peak in September Summers are generally warm and sunny; arctic cold-air masses sometime settle in for several days during the winter, dropping temperatures well below zero.

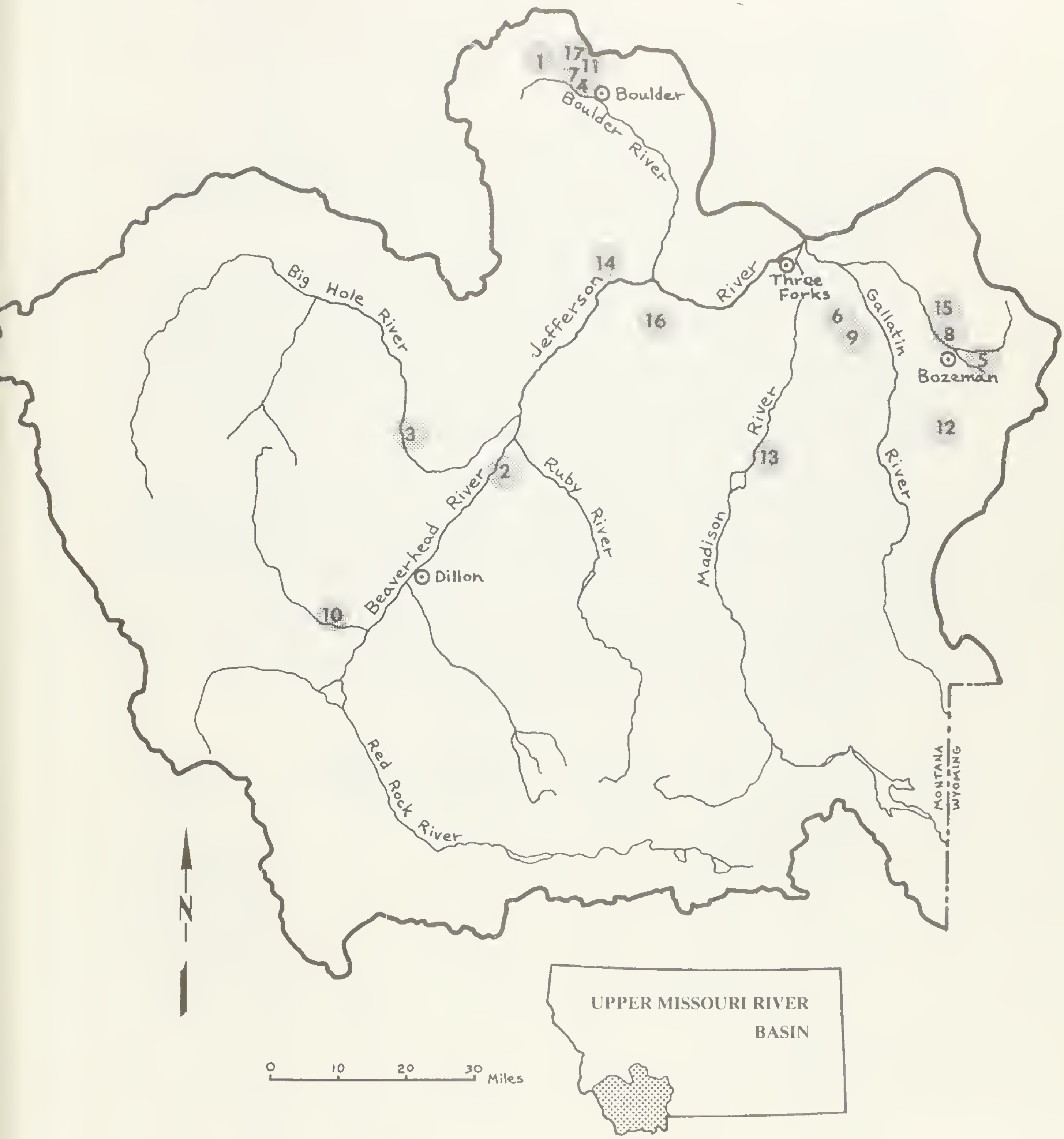
Surface and groundwater quality is generally excellent, however, the basin also includes a nearly complete cross section of Montana water quality problems, such as sediment, temperature, dewatering, nutrients, coliforms, eutrophication and acid mine drainage Quality typically degrades as water flows downstream, picking up salts, carrying higher nutrient loads and increasing in temperature. The numerous reservoirs in the basin tend to average flows and salt concentrations while causing deposition of sediment in slackwater areas and increased streambed erosion below dams.

The eight major rivers that make up the upper Missouri River Basin are: the Red Rock, Beaverhead, Ruby, Big Hole, Jefferson, Boulder, Madison and Gallatin rivers.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Basin Cr.	Boulder R.	A (C)	0.52	Zinc
2	Beaverhead R.	Jefferson R.	A (C)	0.33	Temp,P,TSS,Iron,Gases
			R	0.42	FC, pH, P
			P	0.34	Manganese
			I	0.12	FC
3	Big Hole R below Melrose	Jefferson R	A (C)	*	TSS, Temp
4	Boulder R. below Basin	Jefferson R.	A (C)	1.26	Iron, P, Zinc, Copper, Silver
			R	0.51	pH, P
			P	0.11	Lead

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values *	Problem Parameters
5	Bozeman Cr. below Bozeman	East Gallatin R.	A (C)	1.12	TSS, pH, N
			R	42.30	FC, pH
6	Camp Cr.	Gallatin R.	A (C)	2.49	TSS, pH, N
			R	14.57	FC, pH
			I	13.06	FC
7	Cataract Cr. below Eva May Mine	Boulder R.	A (C)	4.01	TSS, pH, Copper, Zinc
			P	1.12	pH, Manganese
			R	1.05	pH
8	East Gallatin R. below Bozeman WWTP	Gallatin R.	A (C)	0.91	Temp, pH, N, P, NH_3
			P	0.11	pH
			R	1.74	P, pH
9	Godfrey Cr.	Gallatin R.	A (C)	2.69	TSS, N, P, Iron
			P	1.40	Manganese
			R	2.36	PH, P
10	Grasshopper Cr. below Bannack	Beaverhead R.	A (C)	0.28	Copper
11	High Ore Cr. below Comet Mine	Boulder R.	A (C)	7.54	Metals
			P	13.19	Arsenic, Cadmium, Zinc
			I	17.99	Arsenic
			L	8.99	Arsenic
12	Hyalite Cr. below F.S. boundary	East Gallatin R.	A (C)	0.54	TSS, pH, N
			R	13.68	FC, pH
13	Madison R. below Ennis Lake	Missouri R.	A (C)	0.08	Temp
14	Pipestone Cr.	Jefferson R.	A (C)	34.92	TSS, P, Iron
			P	2.60	Manganese
			R	1.90	P
15	Reese Cr.	East Gallatin R.	A (C)	1.78	TSS, pH, N
			R	38.18	FC, pH
16	South Boulder R. below Mammoth	Jefferson	A (C)	1.08	pH
			P	1.08	pH
			R	1.08	pH
17	Uncle Sam Gulch below Crystal Mine	Cataract Cr.	A (C)	14.73	pH, Zinc, Cadmium, Copper
			P	3.16	pH, Cadmium, Manganese
			R	1.09	pH

* Excursions from criteria for TSS and temperature have been documented using data that are not on STORET.



Boulder
Boulder River
Big Hole River
Jefferson
River
Three Forks
Gallatin River
Bozeman
Madison River
Ruby River
Beaverhead River
Dillon
Red Rock River
MONTANA
WYOMING
N
0 10 20 30 Miles
UPPER MISSOURI RIVER BASIN
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

7 - MISSOURI-SUN-SMITH RIVER BASIN

This basin includes all lands drained by a 250-mile stretch of the Missouri River in westcentral Montana from the three forks of the Missouri River to the mouth of the Marias River at Loma. Total drainage area is approximately 11,000 square miles or 7 million acres. Topography in the basin varies from mountainous to rolling plains. The lowest point in the basin is less than 3,000 feet at Loma.

The semi-arid climate of the valleys and rolling plains is typified by cold, dry winters, moist springs and warm, dry summers. Annual precipitation in these areas usually ranges from 10 to 15 inches. Mountain areas, particularly along the Continental Divide, receive significant snowfall during the winter

Agriculture is the leading industry in the basin and livestock production is the major agricultural operation. Irrigated lands account for 280,000 acres and dry croplands cover an additional 900,000 acres. Two-thirds of the area is in private ownership or other non-federal control and is used primarily for range or crops. Management of the federal third is largely for grazing and forest use by the U.S. Forest Service and the Bureau of Land Management.

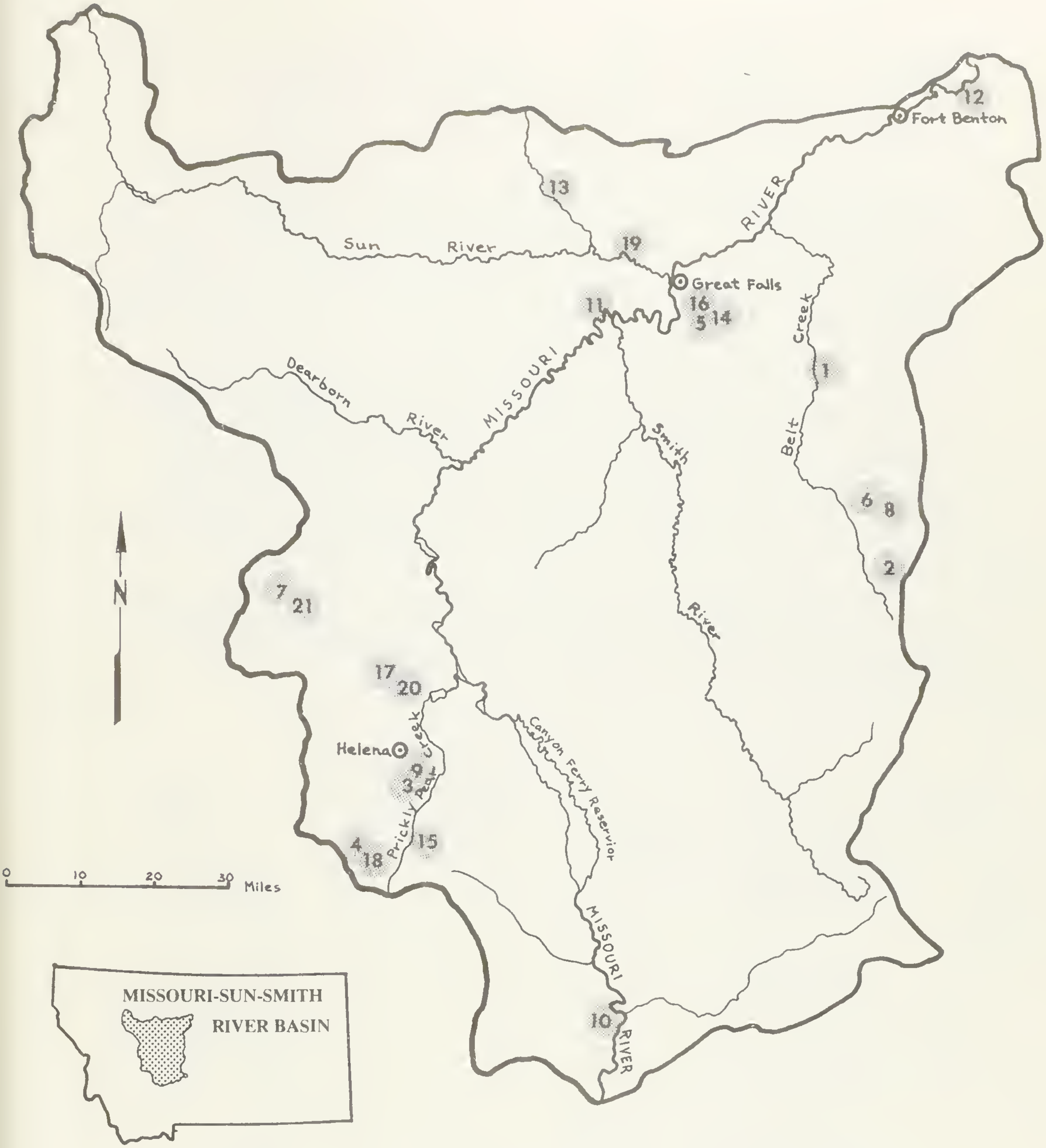
Irrigation is the predominant consumptive use of water in the drainage, consuming an estimated 295,000 acre-feet annually. There are 17 reservoirs and run-of-river impoundments within the basin having at least 1,000 acre-feet of storage each. The three largest are Canyon Ferry and Holter, both on the Missouri River, and Gibson on the Sun River.

Water quality in the basin runs the gamut from some of the best to some of the worst in the state. There are several municipal, agricultural, and industrial discharges in the basin

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Belt Cr. below Dry Fork Belt Cr.	Missouri	A (C)	5.28	TSS, Temp, P, Silver, Iron, Copper, Lead, Zinc, Cadmium
			P	2.57	Manganese, Chromium, Nickel, Lead, Silver, Cadmium
			R	0.29	P
			I	0.23	Iron
			L	0.52	Lead
2	Carpenter Cr.	Belt Cr.	A (C)	1.47	pH, Zinc
			P	1.17	pH, Nickel
			R	1.05	pH
3	Clancy Cr.	Prickly Pear Cr.	A (C)	0.74	TSS, P, Iron, Copper
			P	0.96	Manganese, Lead
			R	0.87	P

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
4	Corbin Cr.	Spring Cr	A (C)	22 42	TSS, pH, Iron, Zinc, Cadmium, Copper
			P	18.34	pH, SO_4, Iron, Copper, Cadmium, Manganese
			R	0 60	pH
			I	1.25	pH, TDS, Iron
			L	4.75	Copper
5	Cottonwood Cr	Sand Coulee Cr.	A (C)	2.17	pH, Metals
			P	13.33	pH, Manganese, Zinc
			R	2.17	pH
			I	1 61	pH, Zinc
6	Dry Fork Belt Cr	Belt Cr.	A (C)	2.93	Iron, Zinc, Copper, Silver, Cadmium
			P	14.87	Iron, Manganese
7	Fool Hen Cr.	Virginia Cr	A (C)	7.90	TSS, Iron, Cadmium, Zinc, Copper
			P	1.50	Lead
			L	0.75	Lead
8	Galena Cr.	Dry Fork Belt Cr.	A (C)	7.60	TSS,Iron,Zinc,Copper, Silver, Cadmium
			P	21.76	Iron, Manganese, Zinc, Cadmium
9	Lump Gulch Cr.	Prickly Pear Cr.	A (C)	0 17	TSS, Iron
			P	0 92	Manganese
10	Missouri R. above Canyon Ferry Res	Mississippi R	A (C)	0 56	TSS, Temp, pH
			P	0.25	pH
			R	0.25	pH
11	Missouri R., Canyon Ferry Dam to Sun R	Mississippi R.	A (C)	0 57	TSS, pH
			P	0 03	pH
			R	0 03	pH
12	Missouri R., Sun R to Fort Peck Res.	Mississippi R	A (W)	0.23	TSS, pH
			P	0.17	SO_4, pH
			R	0.23	pH, P
13	Muddy Creek	Sun R	A (C)	16 85	TSS, Temp, N, P
			P	0 40	TDS, SO_4
			R	1 50	pH, P
			I	0 02	TDS, Sodium
14	Number Five Coulee	Sand Coulee Cr.	A (C)	5 48	TSS, Iron

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
15	Prickly Pear Cr. below Spring Cr.	Missouri R.	A (C)	2.93	TSS, NH_3, Arsenic, Cadmium
			P	4.57	Arsenic, Lead, Manganese, Selenium
			R	5.01	FC, P
			I	3.82	FC, pH, Arsenic, Selenium, Cadmium
			L	0.76	Lead, Arsenic, Cadmium, Selenium
16	Sand Coulee Cr.	Missouri R.	A (C)	2.02	pH, Metals
			P	22.56	pH, Manganese, Zinc
			R	2.02	pH
			I	1.58	pH, Zinc
17	Silver Cr.	Prickly Pear Cr.	A (C)	0.67	Copper, Silver, Mercury
			P	0.63	Mercury, Cyanide
18	Spring Cr. below Corbin Cr.	Prickly Pear Cr.	A (C)	9.58	TSS, pH, P, Iron, Zinc, Copper, Cadmium
			P	2.12	pH, Iron, Lead, Zinc, Copper, Arsenic, Cadmium, Manganese
			R	0.10	pH, P
			I	0.26	pH, Iron, Zinc, Cadmium
			L	0.56	Lead, Copper, Cadmium
19	Sun R. below Muddy Cr.	Missouri R.	A (W)	0.62	TSS, N, P, Temp
			P	0.34	TDS, SO_4
			R	0.52	P
20	Tenmile Cr.	Prickly Pear Cr.	A (C)	1.86	pH, Iron, Zinc, Copper
			P	2.10	pH, Iron, Arsenic, Manganese
			R	0.26	pH
21	Virginia Cr. below Fool Hen Cr.	Canyon Cr.	A (C)	2.48	TSS, Lead, Zinc, Cadmium, Copper
			P	2.33	Lead
			L	1.17	Lead


Fort Benton
12
13
RIVER
Sun River
19
Great Falls
16
5 14
11
Creek
1
Dearborn River
MISSOURI
Smith
Belt
6 8
2
N
7
21
River
17
20
Helena
Creek
9
3
Prickly Pear
Canyon Ferry Reservior
4
18
15
0 10 20 30 Miles
MISSOURI
MISSOURI-SUN-SMITH
RIVER BASIN
10
RIVER

8 - MARIAS RIVER BASIN

The headwaters of the Marias River are along the east slope of Glacier National Park. From the Continental Divide the river flows through the mountains and rolling agricultural country in northcentral Montana to the Missouri River below Fort Benton. The basin drains approximately 9,100 square miles.

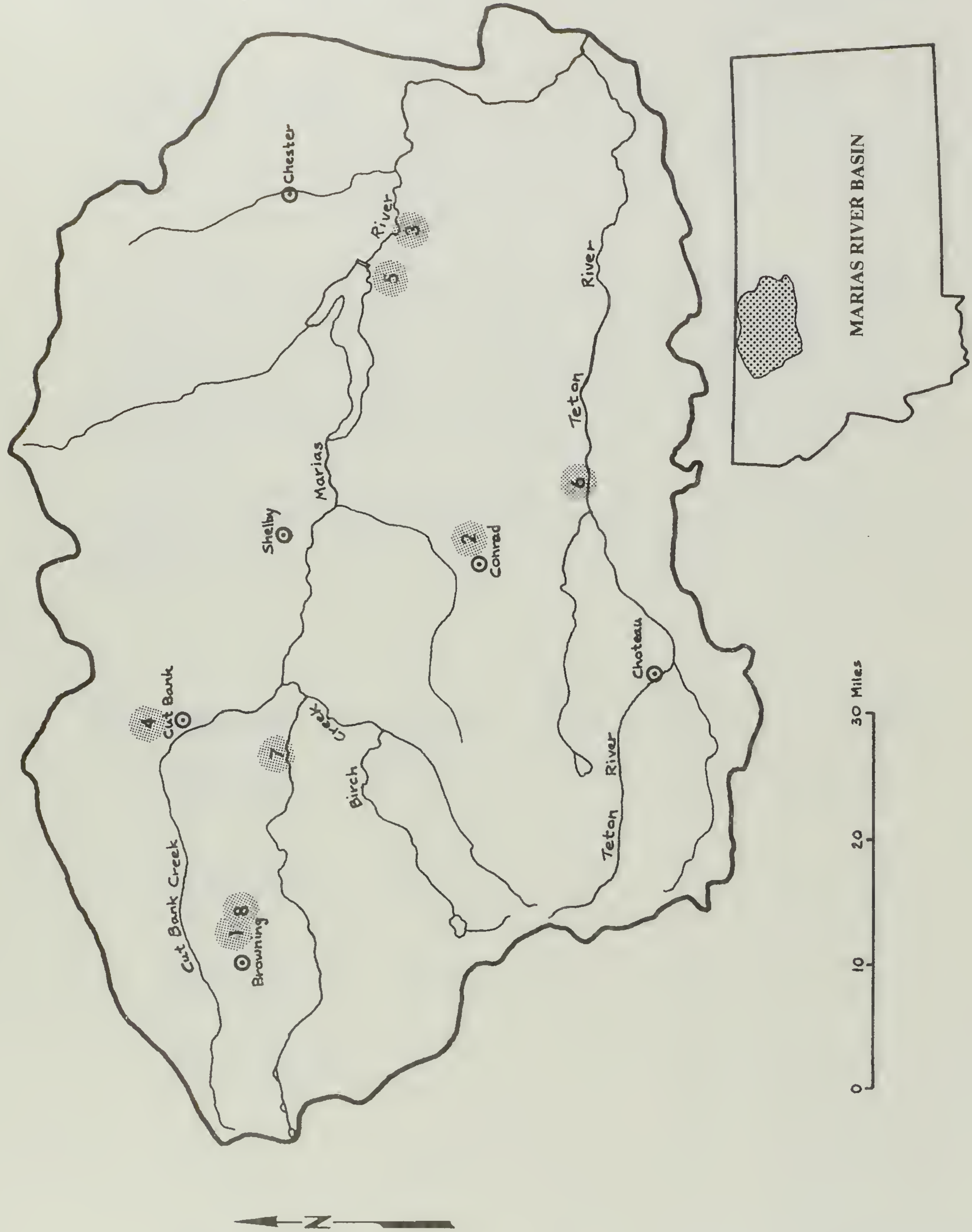
The Marias basin is characterized by hot, dry summers and cold, dry winters. A large portion of the annual precipitation occurs in the spring. Precipitation ranges from 10 to over 30 inches per year, the latter falling in the mountains. Mean monthly temperatures range from -2 degrees F in January to 83 degrees F in July. Wind is a persistent feature of the basin's climate; frequent warm, dry chinook winds may cause rapid snowmelt and flooding.

About 62 percent of the basin lands are used for pasture and range. Croplands comprise 31 percent of the total area; 2 percent is under irrigation and 29 percent is dryland. Irrigated agriculture is the largest water user in the basin, annually diverting approximately 780,500 acre-feet. The major irrigated crop is hay. Forest and woodlands occupy the remaining 7 percent of the basin. Oil and gas production occurs throughout the basin. The urban population is small; only about 15,000 people live in the nine largest communities.

The principal rivers are the Marias and the Teton. Water quality is good to excellent in the western headwaters region, but degrades as the rivers flow from west to east. The predominant pollutants are sediment and salt.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Depot Cr. below Browning WWTP	Willow Cr.	A (C)	9.80	NH_3, pH, N, P
			P	2.10	pH, Ammonia
			R	16.52	pH, P
2	Dry Fork Marias R. below Conrad WWTP	Marias R.	A (W)	0.12	Temp
			P	0.73	TDS, SO_4, pH
			R	0.85	FC, pH
3	Marias R. below Pondera Coulee	Missouri R.	P	0.26	pH, SO_4
			R	0.28	pH
4	Old Maid's Coulee below Cut Bank WWTP	Cut Bank Cr.	A (C)	8.20	N, P
			P	1.40	Ammonia
			R	15.00	P
			I	1.21	TDS
5	Pondera Coulee	Marias R.	I	0.52	TDS
6	Teton R. below Muddy Cr. near Collins	Marias R.	P	4.40	SO_4
			I	1.56	TDS, Sodium

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
7	Two Medicine R below Badger Cr	Marias R.	A (C)	0.09	Temp
8	Willow Cr. below Depot Cr.	Cut Bank Cr.	A (C)	3.04	pH, DO, N, P
			P	0.66	pH, Ammonia
			R	4.56	pH, P


MARIAS RIVER BASIN
Chester
Marias
River
Shelby
Conrad
Teton
River
Choteau
Cut Bank
Cut Bank Creek
Birch
Creek
Browning
Teton
River
1
2
3
4
5
6
7
8
0
10
20
30 Miles
N

9 - MIDDLE MISSOURI RIVER BASIN

The middle Missouri River Basin has as its axis the 275 miles of the Missouri River that flows from Fort Benton to the Fort Peck Dam.

The upper third of the basin is rolling, relatively roadless prairie, broken by the spectacular and rugged white cliffs of the Missouri River Breaks, with the Bear Paw Mountains looming to the north The middle stretch flows under the Fred Robinson Bridge, the only bridge between Fort Benton and Fort Peck Dam, east through the Charles M. Russell Wildlife Refuge where cattle and wildlife graze on rough, prairie land. The lower third of the basin encompasses the sprawling Fort Peck Reservoir, which is surrounded by the refuge and "badlands."

The basin is typified by low annual rainfall and temperature extremes. Annual precipitation averages between 11 and 15 inches, with June the wettest month. Snowmelt from the minor mountain ranges that dot the area add to flows between April and June

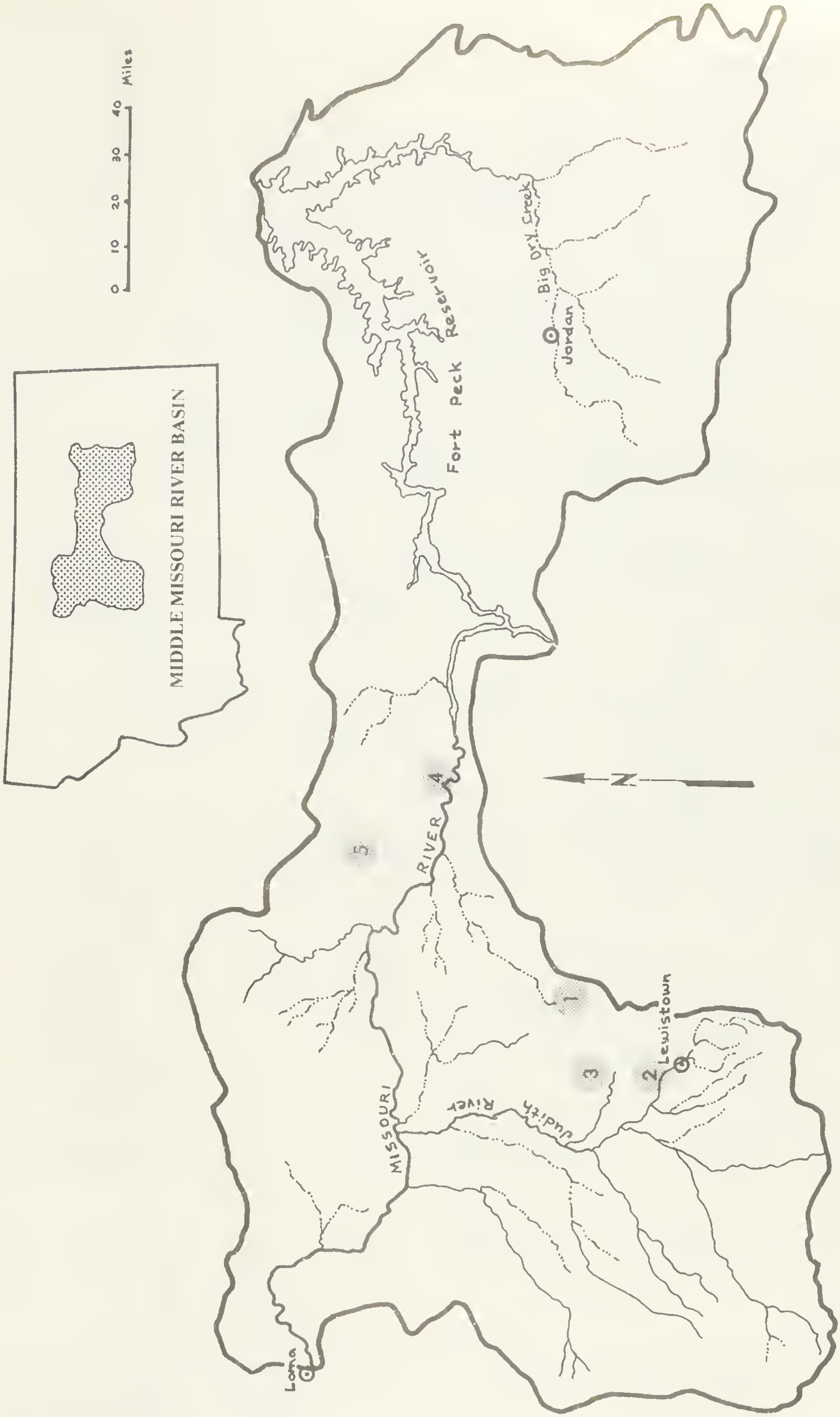
The only major population center is Lewistown, with fewer than 10,000 residents. The western part of the basin has a greater percentage of grain-growing land, while the east has more rangeland, which is the largest land use in the basin. The largest water use in the basin is for irrigation, diverting approximately a quarter-million acre-feet annually.

The basin has substantial energy resources in the form of petroleum and coal. There is continuing petroleum exploration and production, but it has had little impact on water quality. There are large deposits of strippable coal in the southern and eastern portions of the basin. These have yet to be developed, but could result in coal mining and synthetic fuel production.

The basin contains only a few municipal and two industrial dischargers and several feedlots. However, natural sediment and salts, amplified by agricultural practices, are the dominant spoilers of the basin's water quality. These pollutants emanate from irrigation returns, poor soil conservation practices, saline seep, overgrazing and natural erosion.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Armells Cr.	Missouri R	A (C)	0.50	pH, Iron
			P	2.48	pH, Iron
			R	0.48	pH
2	Big Spring Cr. below Lewistown WWTP	Judith R	A (C)	0.36	pH, P
			R	0.36	pH, P
3	Mason Gulch	Judith R.	A (C)	2.54	Iron
			P	5.80	Manganese

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
4	Missouri R., Sun R. to Fort Peck Res.	Mississippi R.	A (W)	0.23	TSS, pH
			P	0.17	SO_4, pH
			R	0.23	pH, P
5	Montana Gulch	Missouri R.	A (C)	7.66	Iron, Zinc
			P	1.00	Arsenic



MIDDLE MISSOURI RIVER BASIN
0 10 20 30 40 Miles
Fort Peck Reservoir
Big Dry Creek
Jordan
N
RIVER
MISSOURI
Judith River
Lewistown
Loma
1
2
3
4
5

10 - MUSSELSHELL RIVER BASIN

The Musselshell River originates at the confluence of its north and south forks east of Martinsdale. From its origin in the Little Belt Mountains, the river flows in an easterly direction for 125 miles along the southern flank of the Big Snowy Mountains. The river then heads north for 55 miles to Fort Peck Reservoir The Musselshell and its tributaries drain an area of approximately 8,000 square miles.

The basin terrain generally may be described as hilly. Soils in the basin are as varied as the physiographic features. The valley of the Musselshell, which contains the basin's more desirable farmland, is less than a mile wide and is bordered by sandstone rimrocks and rugged shale breaks along most of its course.

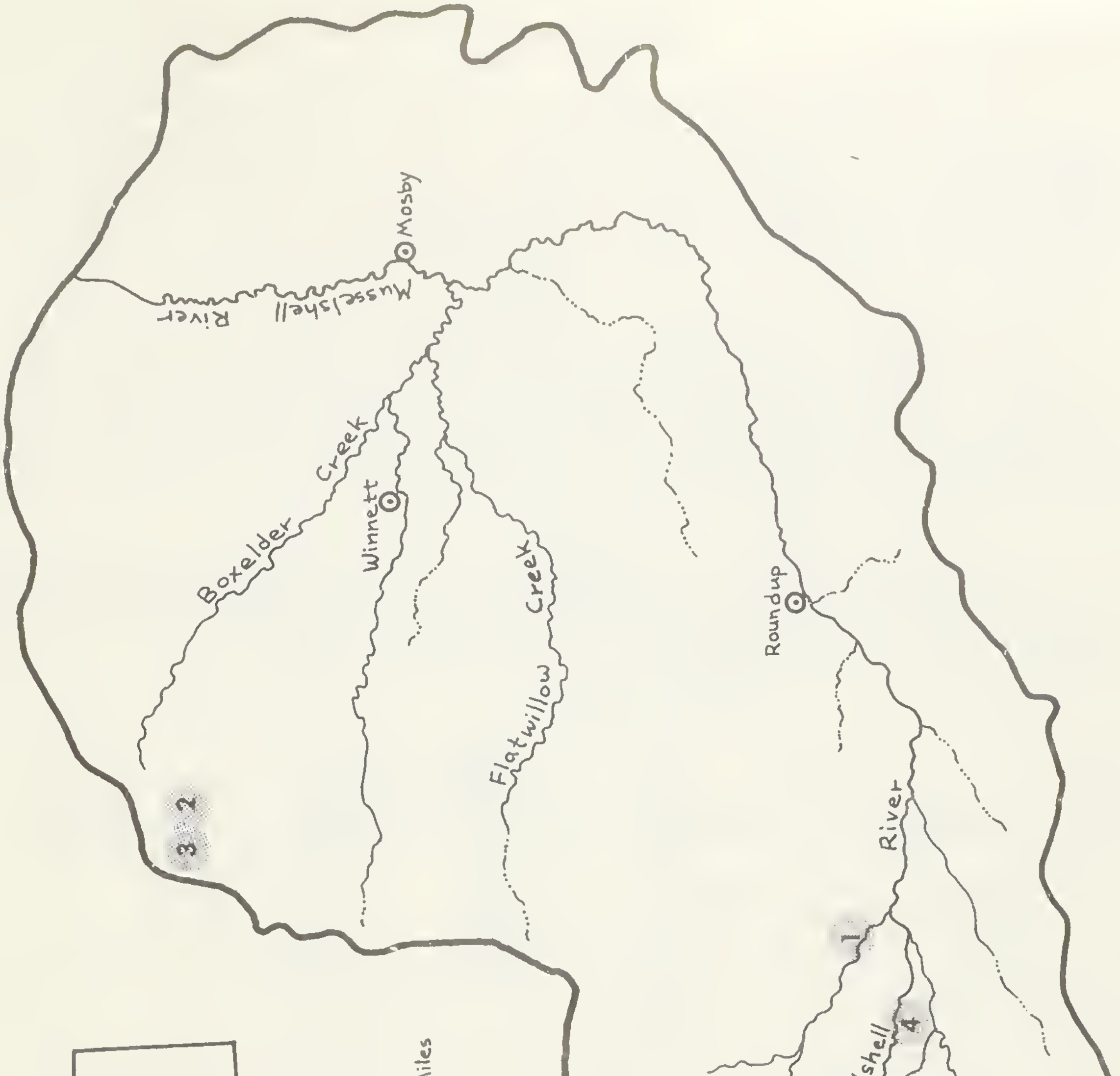
The Fort Union coal formation is present in the central portion of the basin near Roundup. The formation contains commercial coal beds under development southeast of Roundup.

The Musselshell Basin is best described as a semi-arid region with a short growing season. Average annual precipitation is around 12.5 inches. Forty to fifty percent falls in the spring, with June the wettest month. The various mountain ranges contribute some snowmelt runoff.

The basin is rural. The largest land use is privately owned rangeland, comprising 67 percent of the basin. Irrigation is the basin's largest water consumer, diverting nearly one-half million acre-feet annually.

Water quality problems in the basin are predominantly natural; some are aggravated by logging and agriculture. Some saline seep occurs The quality of Musselshell water becomes more and more degraded, due to sediment and salts, as it travels toward the Fort Peck Reservoir.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Careless Cr. below Deadman's Canal	Musselshell R.	A (W)	0.92	TSS, P, Iron
			P	2.18	TDS, SO_4, Manganese
			I	0.64	TDS, Sodium
2	Chicago Gulch	Box Elder Cr.	A (C)	1.77	pH, Iron, Zinc, Cadmium
			P	1.59	pH, Lead
			R	1.18	pH
3	Coller Gulch	Box Elder Cr.	A (C)	2.16	Lead, Zinc
			P	3.02	pH, Lead
			R	1.05	pH
			L	2.50	Lead
4	Musselshell R. below Deadman's Basin Reservoir Diversion	Missouri R.	A (W)	0 19	TSS, P
			P	1.37	TDS, SO_4, pH, Nickel
			R	0.21	FC, pH, P
			I	0.66	TDS, Sodium



MUSSELSHELL RIVER BASIN
Musselshell River
Mosby
Boxelder Creek
Winnett
Flatwillow Creek
Roundup
Musselshell River
Harlowton
1
2
3
4
0 10 20 30 40 Miles
N

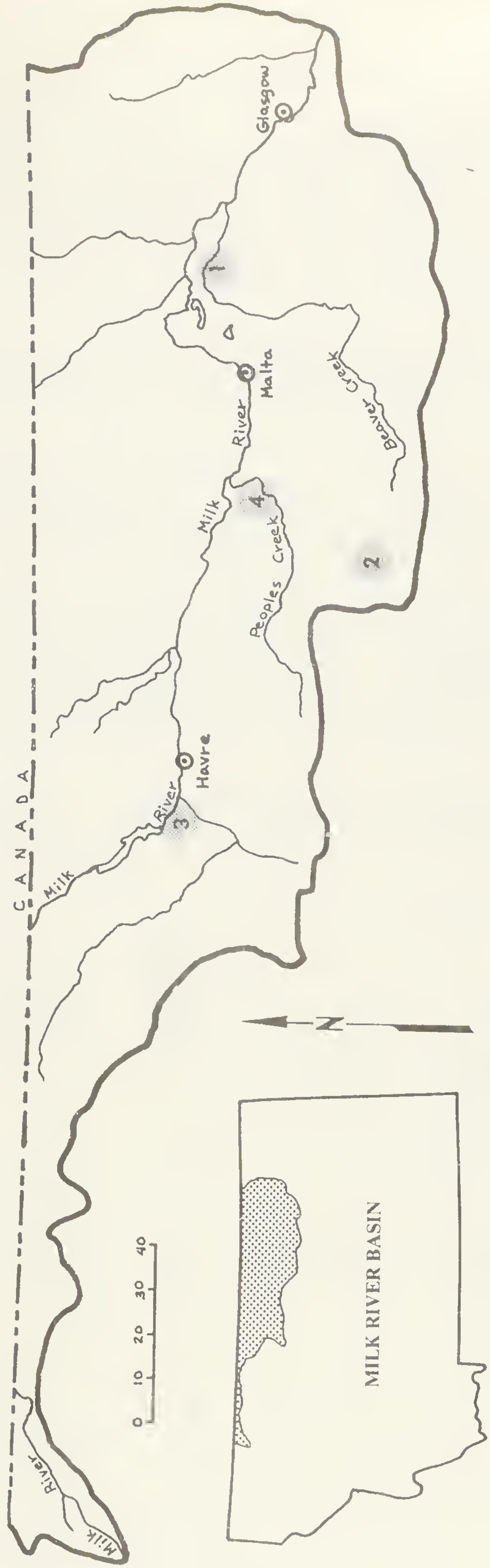
11 - MILK RIVER BASIN

The Milk River originates in Glacier National Park, flows into Canada, then re-enters the U.S. and heads east to its confluence with the Missouri River below Fort Peck Dam. The basin drains about 15,000 square miles. The major geologic event that influenced soils of the Milk River Basin was continental glaciation, which resulted in the filling of many stream valleys with alluvium.

The largest land use in the basin is privately owned rangeland, constituting about 45 percent of the total land area. The next largest is federal forest and rangeland, which accounts for about 28 percent. Cropland takes up about 23 percent, mostly in dryland grain production in the western half of the basin. Irrigation is the largest water user, diverting about 1.5 million acre-feet annually.

There are several industrial and agriculture waste discharges and at least a dozen municipal waste discharges. Sediment and salts are the major despoilers of basin waters. The sources include poor grazing and cropping practices, irrigation returns and saline seeps

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Beaver Cr. below Lake Bowdoin	Milk R.	A (W)	2.05	TSS, P
			P	1.66	TDS, SO_4
			R	1.98	P
			I	0.55	TDS
2	Little Peoples Cr.	Little Rocky Cr.	A (C)	0.13	TSS
			P	0.80	Iron, Nickel
3	Milk R. below Fresno Dam	Missouri R.	A (W)	0.11	TSS, P
			P	0.43	TDS, SO_4
			R	0.03	FC, P
			I	0.22	TDS, Sodium
4	Peoples Cr.	Milk R.	A (W)	0.03	Temp
			P	1.31	TDS, SO_4, pH
			R	0.50	pH
			I	0.52	TDS, Sodium


CANADA
Milk
River
Havre
Peoples Creek
Milk
River
Malta
Beaver Creek
Glasgow
1
2
3
4
N
0
10
20
30
40
MILK RIVER BASIN

12 - LOWER MISSOURI RIVER BASIN

The lower Missouri River runs from below Fort Peck Dam to the Montana-North Dakota boundary. The basin has a total area of about 10,000 square miles with elevations ranging from 3,500 feet in the Big Sheep Mountains to 1,900 feet at the North Dakota border. Topography varies between rolling hills and flat plains that are occasionally cut by stream valleys, sometimes forming badlands-type pinnacles, bluffs and steep banks.

A continental type climate is typical for the basin. Winters are cold, summers are warm and springs are wet. Precipitation varies from 10 to 14 inches in the western portion to about 17 inches annually in the east.

The largest land use in the basin is privately owned rangeland, which constitutes about 40 percent of the total land area. The next largest is cropland at about 33 percent. State and federal rangeland make up about 19 percent of the land area.

The largest town is Wolf Point, with about 3,000 residents. There remains a vast amount of strippable coal under the southern part of the basin. Oil and gas development in the Williston Basin have recently stimulated growth in the area. The largest water use in the Lower Missouri Basin is irrigation, diverting about 270,000 acre-feet annually

Natural waters of the basin generally are of only fair quality, being high in sodium and sulfates and providing warm-water habitats for aquatic life.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	East Fork Poplar R.	Poplar R.	A (C)	0.42	TSS, N, P, pH, Temp, DO, Iron, NO_2
			P	0.61	Manganese, Iron, Ammonia, SO_4, pH
			R	0.43	pH, P
			I	0.60	pH, TDS, Sodium
2	Missouri R. below Fort Peck Dam	Mississippi R.	A (W)	0.31	TSS, N, P
			P	0.62	TDS, SO_4, pH, Iron, Ammonia
			R	0.11	pH, P
			I	0.12	TDS, Sodium
3	Poplar R.	Missouri R.	A (C)	0.98	TDS, Temp, P, Iron, pH
			P	0.85	SO_4, pH
			I	0.78	TDS, Sodium

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
4	Redwater R.	Missouri R.	A (W)	0.24	TSS, DO, NH_3, P, pH, Temp
			P	2.31	Manganese, TDS, SO_4, pH
			R	0.48	pH, P
			I	1.76	TDS, Magnesium, Sodium, pH


Scobey
Plentywood
1
Poplar River
Big Muddy Creek
3
Culbertson
RIVER
Wolf Point
MISSOURI
2
River
4
Redwater
Circle
N
0 10 20 30 Miles
LOWER
MISSOURI RIVER
BASIN

13 - UPPER YELLOWSTONE RIVER BASIN

The upper Yellowstone River Basin in southcentral Montana encompasses the eastern slopes of the Rocky Mountains and the western edge of the Great Plains. Elevations descend from 12,799 feet (Granite Peak--the highest point in Montana) down to 3,300 feet.

The Montana portion of the basin is drained by the Yellowstone River and all of its tributaries from the state line in Yellowstone National Park to below the mouth of the Clark's Fork.

The Clark's Fork River Valley near Belfry is the driest part of the basin and one of the driest in Montana. The average annual precipitation there is only about six inches. Precipitation in the mountains is up to 35 inches per year.

More than 100,000 people live in the basin, most of them in Billings. This is the largest urban and industrial center in Montana. The Billings area has three petroleum refineries, two major municipal wastewater discharges, a sugar beet refinery and a power plant with a heated discharge. However, agriculture is still the area's predominant economic activity. The largest water user is irrigation, depleting almost 800,000 acre-feet per year.

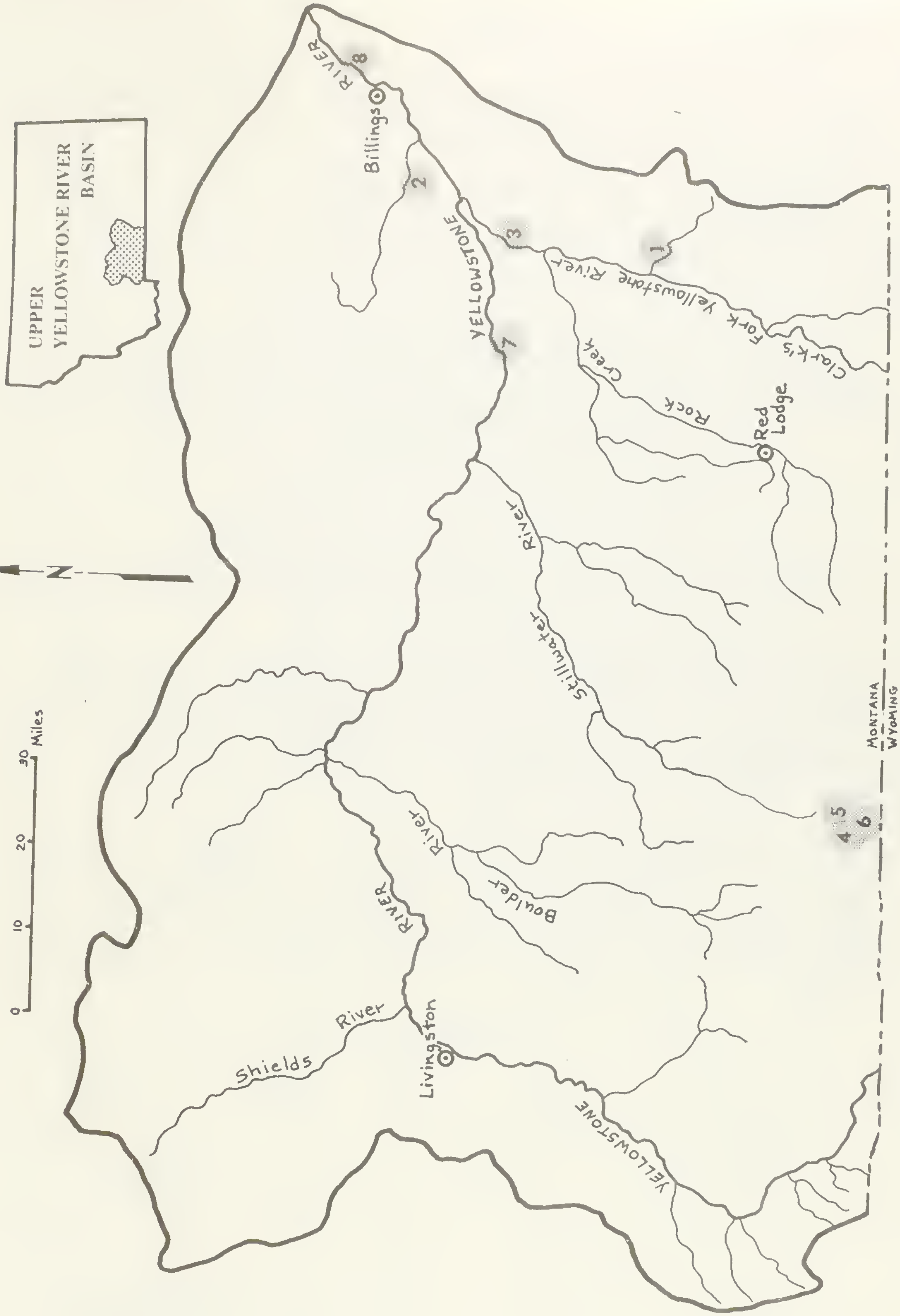
About 30 percent of the basin is forest land. Much of the basin offers recreational opportunities, including 95 miles of "blue ribbon" trout fishing on the Yellowstone River from Yellowstone Park to near the town of Big Timber.

Except for acid-mine drainage in certain tributaries, water quality in headwater streams near Yellowstone Park is excellent. The mainstem and larger tributaries pick up dissolved solids and suspended sediment as they proceed downstream. They also become warmer. The Clark's Fork of the Yellowstone is unique among the major tributaries in that it has only fair to poor water quality due to high turbidity and sediment loads. The segment of the Yellowstone near the mouth of the Clark's Fork is a transition zone between cold and warm-water aquatic life.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Bluewater Cr. below Orchard Canal	Clark's Fork R.	A (C)	3.25	TSS
2	Canyon Cr	Yellowstone R	A (C)	5.48	TSS, Temp, N, P
			P	2.08	TDS, SO_4
			R	0.54	P
			I	0.72	TDS, Magnesium, Sodium
3	Clark's Fork R.	Yellowstone R.	A (C)	4.25	TSS, DO, N, P, Temp, Iron
			P	1.61	pH, Manganese, SO_4, Ammonia, Nickel
			R	0.62	pH, P
			I	0.21	Sodium

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
4	Daisy Cr. below McLaren Mine	Stillwater R.	A (C)	*	Iron, Copper, Sulfate, pH
5	Fisher Cr. below Glengary Mine	Clark's Fork R	A (C)	53.11	pH, Copper
			P	1.64	pH, Copper
			R	2.04	pH
			I	1.42	pH
			L	2.50	Copper
6	Soda Butte Cr. below McLaren Tailings	Lamar R.	A (C)	2.93	Iron
			P	9.77	Iron
7	Yellowstone R. above Clark's Fork R.	Missouri R.	A (C)	0.43	TSS, P
			R	0.05	P
8	Yellowstone R., Clark's Fork R. to Pryor Cr.	Missouri R.	A (C)	0.60	TSS, Temp, pH, P, DO
			P	0.58	Manganese, pH, Ammonia
			R	0.35	FC, pH, P

* Excursions from criteria for parameters indicated have been documented using data that are not on STORET.


UPPER
YELLOWSTONE RIVER
BASIN
N
0
10
20
30
Miles
Billings
RIVER
YELLOWSTONE
Clark's Fork Yellowstone River
Rock Creek
Red Lodge
Stillwater River
Boulder River
RIVER
Livingston
Shields River
YELLOWSTONE
MONTANA
WYOMING
1
2
3
4
5
6
7
8

14 - MIDDLE YELLOWSTONE RIVER BASIN

The middle Yellowstone Basin is on the western edge of the Great Plains. It includes the Yellowstone River and all of its tributaries from the confluence of Pryor Creek at Huntley to the confluence of the Tongue River at Miles City.

The basin is generally an area of rolling hills with gentle to moderate relief. The Bighorn Mountains spread into the southwest portion of the basin, giving that area a mountainous character. The basin drains 10,600 square miles.

Some of the soils in the basin are poorly drained and have a high salt content. The mountains bordering the basin create a moisture shadow. Sufficient snow falls in the mountains to give distinct runoff periods in the spring. Average annual precipitation for the basin is 11 to 16 inches, mostly falling in late spring and early summer.

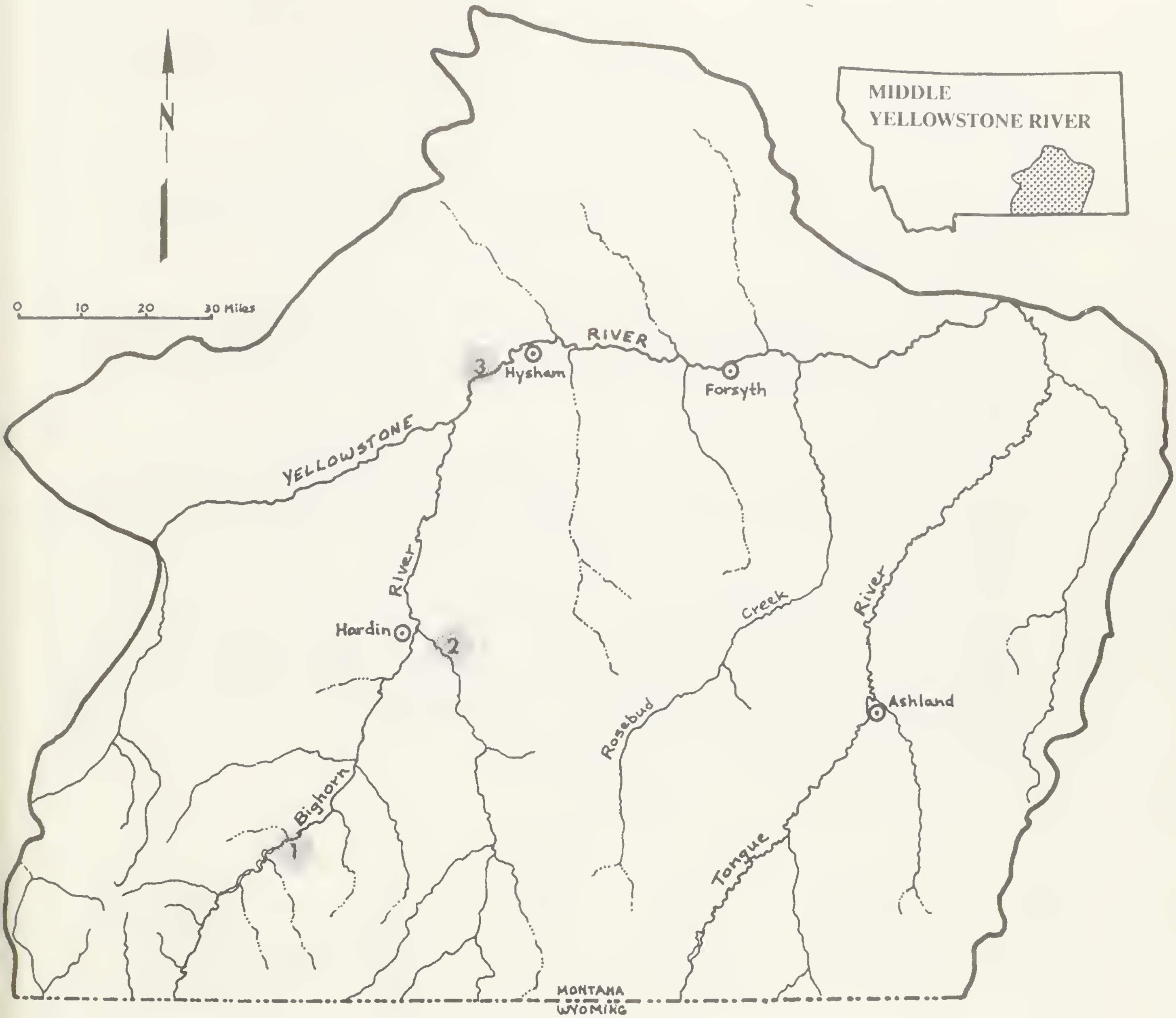
About 75 percent of the basin's land is used for pasture and range. Forests occupy about 7 percent.

More than 90 percent of Montana's coal production occurs in this basin. Underlying the basin is the Fort Union Formation, which contains a large percentage of the strippable coal in the United States.

Irrigated agriculture is the primary water user, depleting more than one-half million acre-feet per year. Industrial use has been negligible, but increasing and largely speculative demands for water have been made by energy concerns for power plants, coal-conversion facilities and coal-slurry pipelines. Increased coal and energy production would also bring about a large increase in population.

Water quality generally declines from southwest to northeast through the basin as streams warm and pick up dissolved and suspended materials. Quality is best in the headwaters of the larger tributaries on the south side of the Yellowstone and worst in smaller tributaries heading closer to the mainstem. Most streams support warm-water fisheries except portions of the Bighorn, Rosebud Creek and Tongue River drainages.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Bighorn R. below Yellowtail Dam	Yellowstone R.	A (C)	0.36	Gases, pH, P, TSS, Temp
			P	0.25	TDS, SO_4, pH
			R	1.04	pH, FC, P
2	Little Bighorn R.	Bighorn R.	A (C)	0.11	Temp
3	Yellowstone R., Pryor Cr. to Tongue R.	Missouri R.	A (W)	0.78	TSS, Iron, NH_3, P
			P	0.63	Manganese, SO_4, pH, Nickel
			R	0.27	pH, P


MIDDLE
YELLOWSTONE RIVER
N
0
10
20
30 Miles
YELLOWSTONE
RIVER
Hysham
3
Forsyth
River
Hardin
2
Creek
River
Ashland
Rosebud
Bighorn
1
Tongue
MONTANA
WYOMING

15 - LOWER YELLOWSTONE RIVER BASIN

The lower Yellowstone River Basin includes the Yellowstone River and all of its tributaries from Miles City (excluding the Tongue River) to the North Dakota border. With the exception of the Powder and Yellowstone rivers, most streams in this basin are small and many have intermittent flows. The basin drains about 11,650 square miles, an area of sparsely forested rolling hills and prairie grasslands.

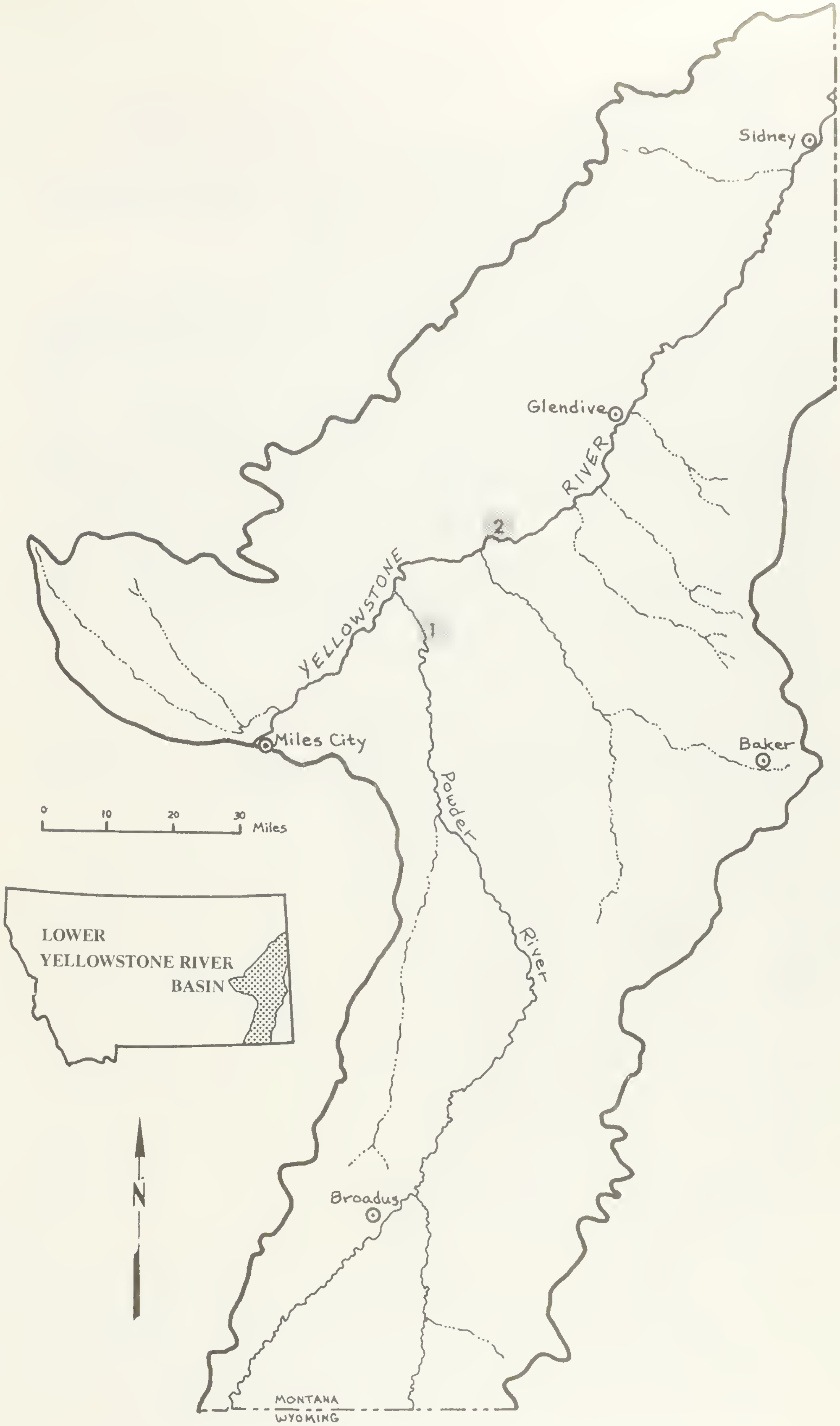
Elevations in the basin range from 2,000 to 5,000 feet. The basin's climate is typical of the semi-arid Northern Great Plains, with dry, cold winters, warm summers, variable rainfall and low humidity. June is usually the wettest month and average annual precipitation ranges between 12 and 14 inches.

Sixty-two percent of the basin is rangeland and used for livestock grazing. Cropland takes up only 15 percent of the basin and only 12 percent of that is irrigated, mostly along the Yellowstone River. The basin is largely rural.

The primary water use is for irrigation to produce hay. At least 750,000 acre-feet of water a year is diverted, with about 185,000 acre-feet consumed or depleted. Water use will increase as coal reserves are developed. The Fort Union Formation lies under part of the basin.

With the exception of the Yellowstone River and one or two others, streams in the basin have naturally poor quality water because of high sediment loads and large concentrations of salts. One stream, the Powder River, had been described as "a mile wide and an inch deep, too thick to drink and too thin to plow." Most streams in the basin support warm-water aquatic life.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Powder R.	Yellowstone R.	A (W)	18.58	TSS, Temp, P
			P	1.94	TDS, Chloride, Iron, SO_4, pH
			R	1.74	FC, P, pH
			I	1.05	FC, TDS, Sodium
2	Yellowstone R., Tongue R. to North Dakota border	Missouri R.	A (W)	1.16	TSS, P
			P	0.53	TDS, Iron, SO_4, pH
			R	0.34	pH, P


Sidney
Glendive
RIVER
YELLOWSTONE
2
1
Miles City
Baker
Powder
River
0
10
20
30
Miles
LOWER
YELLOWSTONE RIVER
BASIN
N
Broadus
MONTANA
WYOMING

16 - LITTLE MISSOURI RIVER BASIN

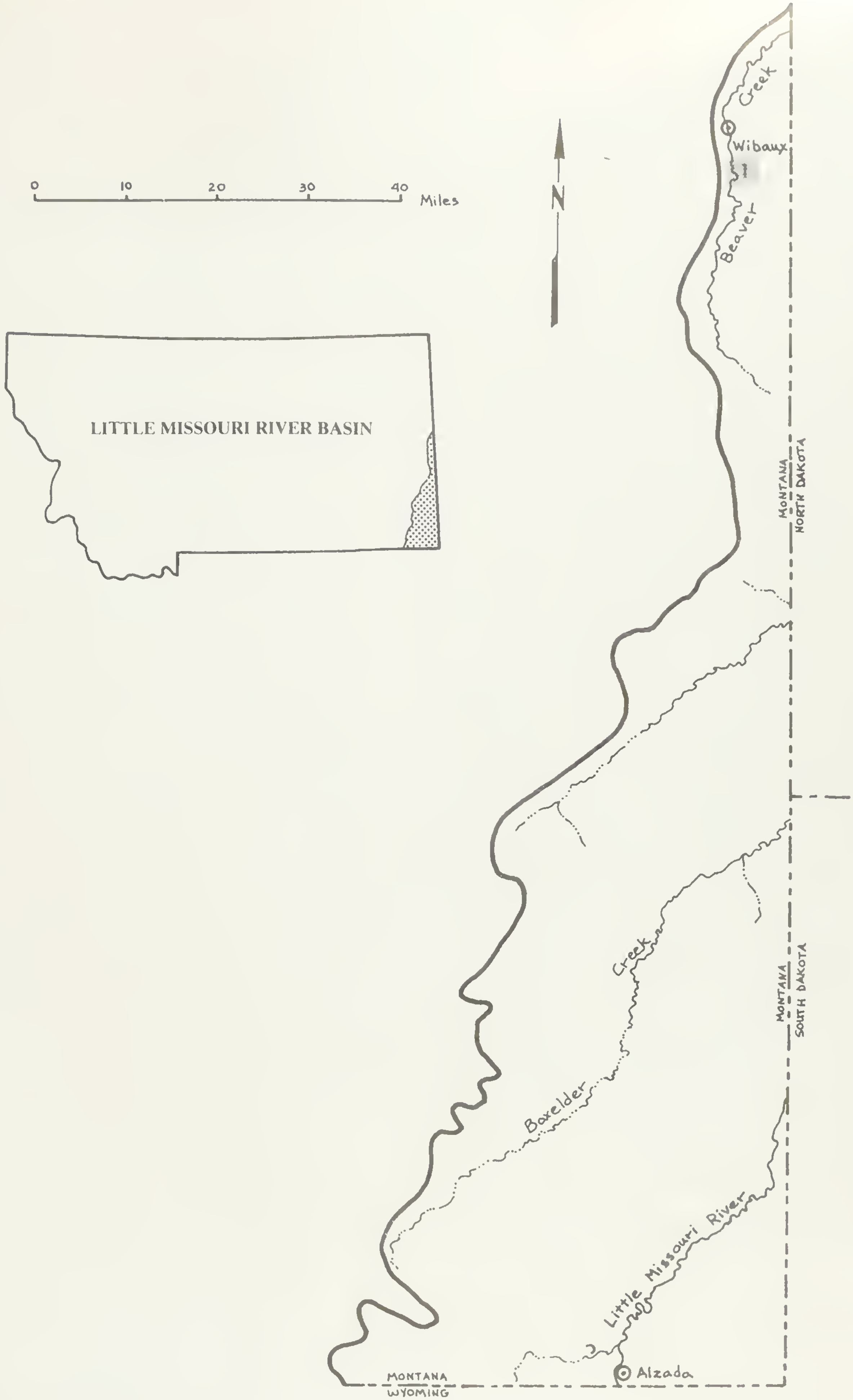
The Little Missouri River Basin covers about 3,360 square miles in extreme southeastern Montana. The basin is an area of rolling hills with gentle to moderate relief. An area of about 11 square miles in the extreme southeast corner of the basin drains into the Belle Fourche River in Wyoming and South Dakota. All of the remaining streams are tributary to the Little Missouri River, which in turn flows into the Missouri River at Lake Sakakawea, North Dakota.

The Little Missouri River Basin has a semi-arid continental climate, with cold dry winters, cool moist springs and warm summers. The average annual precipitation for the area ranges from 11 to 14 inches. Approximately 75 percent of the precipitation falls from April through September.

Most of the basin is used for dryland and irrigated crops and for range. Approximately 80 percent of the area is classified as grazing land. About 182,000 acres are under cultivation with about 42,000 of these acres irrigated. The predominant water use in the basin is for irrigation.

Surface water quality throughout the basin ranges from fair to poor. There is a heavy reliance on groundwater for stock and domestic supplies.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Use Impairment Values	Problem Parameters
1	Beaver Cr.	Little Missouri River	A (W)	0.39	TSS, P
			P	3.09	Manganese, SO_4
			R	0.40	P
			I	1.24	TDS, Sodium



0
10
20
30
40
Miles
N
LITTLE MISSOURI RIVER BASIN
Creek
Wibaux
Beaver
MONTANA
NORTH DAKOTA
Creek
Boxelder
MONTANA
SOUTH DAKOTA
Little Missouri River
Alzada
MONTANA
WYOMING

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